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The Role of Northwest Hardwoods in International Trade

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C. Buhler and D. G. Briggs

CENTER FOR INTERNATIONAL TRADE IN FOREST PRODUCTS
UNIVERSITY OF WASHINGTON
COLLEGE OF FOREST RESOURCES AR-10
SEATTLE, WASHINGTON 98195

THE ROLE OF NORTHWEST HARDWOODS IN INTERNATIONAL TRADE

Craig Buhler
Research Assistant

David G. Briggs
Associate Professor and Principal Investigator

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College of Forest Resources, AR-10
University of Washington
Seattle, Washington

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INTRODUCTION

Although comprising a small fraction of the forest resource in the Pacific Northwest (PNW), the region's hardwoods are becoming an increasingly important sector in terms of both domestic and overseas markets. This has occurred despite a generally negative attitude among foresters and the general public. This attitude has been fostered by a variety of factors. Perhaps foremost is the common situation in which lands logged of coniferous stands are invaded by light-seeded, pioneering, fast growing hardwoods, especially red alder. Because this invasion prevents natural restocking of conifers and frequently overwhelmed planted conifer seedlings, hardwoods became viewed as pests. Prior to the 1960's and 70's, vast areas of former conifer lands became covered by vigorous stands of hardwoods. Since that time, foresters have invested substantially in hardwood control programs. Young hardwoods were sprayed or manually removed during early thinnings to prevent competition with planted conifers. Older hardwood stands were converted to conifers by logging off the hardwoods, salvaging better material for lumber or chips, and replanting with conifers. These activities, combined with various statements in corporate and public agency reports of what was being done to eliminate the hardwood problem and get lands back into productive conifers, conveyed an impression to the public that hardwoods were worthless weeds. Furthermore, early use of red alder in hidden parts of furniture and as an inexpensive substitute that was often stained to imitate other woods reinforced its reputation as a lesser species. Unfortunately, these attitudes have persisted while alder has gained acclaim in both national and international markets for furniture lumber and for pulp chips. It is widely regarded for its many good properties and, in furniture, for its versatility to be used naturally or to imitate many other species. Interest has also grown in several other Northwest hardwood species. Indeed, during the recession of the early 1980's, a Weyerhaeuser executive stated "In the 1980's, we suddenly found that our most consistently profitable lumber operations in the (Northwest) region were two small alder mills, which were developing customer ties in the Japanese and California furniture industries." (Bingham, 1986).

Although many are becoming aware of the increased value of the PNW hardwoods, there is little current information on the present size and scope of industries using the resource, developments in markets and the resource base and issues or problems that are confronting this industry. This study had the following objectives:

- To characterize the importance of PNW hardwoods in international trade. This included:
    - estimating quantities and values of various product forms entering export markets,
    - comparing the export activity based on PNW hardwoods to domestic activity, and
    - identifying important purchasing countries, and
- To discover problems and opportunities that may affect future export capability. This included:
    - characterizing the most recently available resource information to determine if increased future harvests are possible and to identify resource issues that may affect future supply.
    - identifying opportunities for expanding this industry with various forms of value-added manufacture.

In performing this study we limited the scope of investigation to the primary product forms of logs, chips, lumber, and veneer/plywood. Because of difficulties in the statistical tracking the secondary products according to species, we did not attempt to examine secondary products such as pre-cut furniture components, furniture, etc.

THE PNW HARDWOOD SPECIES

Appendix I presents brief descriptions of the PNW hardwood species along with a summary of their wood properties. Commercially, the resource is dominated by red alder primarily used for furniture and pallet lumber and for pulp chips. In addition, big leaf maple, Oregon white oak and Oregon ash are used in applications similar to their more familiar eastern maple, white oak and ash counterparts. Cottonwood is locally important for veneer and pulp chips and is considered a prime candidate for short rotation production of pulp chips. Tanoak is also used for pulp chips and makes excellent flooring and veneer.

At present, there is no mechanism for gathering production and trade statistics on the various PNW hardwoods by species and product form. In many cases they are aggregated together as western hardwoods, placed in a miscellaneous grouping, or are combined with their respective eastern cousins. Only red alder is occasionally singled out with separate statistics.

THE PNW HARDWOOD RESOURCE

This section briefly describes the inventory and ownership of PNW hardwoods. The inventories on which the cited data are based were conducted in the 1970's; hence some of the information may not reflect recent changes. New inventories are underway which will provide important insights as to how the resource is changing.

Area

Hardwoods occupy about 4.3 million acres of which 53% is in Oregon and 47% is in Washington (Table 1). This represents lands where hardwoods occur in pure stands or in mixtures where they comprise a majority of the stocking. Public agencies are responsible for 26% of these lands. Public ownership is higher in Oregon (34%) than in Washington (18%). Forest industry ownership is nearly the same (32-33%) in both states while non-industrial private ownership is higher in Washington (50%) than in Oregon (34%) and about 42% overall.

Table 1. The Hardwood Land Area in Western Oregon and Washington

Land Area: = 4,266,000 Acres
of which Oregon = 53%
Washington = 47%

A. Distribution by owner class, %

	OR	WA	Combined
Industry	32	33	32
Other private	34	50	42
Total private	66	83	74
USFS	18	1	10
BLM	7	--	4
Other public	9	16	12
Total public	34	17	26
	100	100	100

B. Distribution by Species, %

	OR	WA	Combined
Red alder	49	85	66
Bigleaf Maple	8	8	8
Oregon white oak	4	--	2
Black cottonwood	--	3	2
Others	39	4	22
	100	100	100

Source: Bassett & Oswald 1981a, 1981b, 1982; Gedney, Bassett & Mei 1986a, 1986b, 1987; Bassett 1979; Mei 1979; Jacobs 1978.

The species composition of these lands is almost 66% red alder, 8% bigleaf maple, 2% each cottonwood and Oregon white oak, and 22% other species. The species mix of the two states is quite different. In Washington 85% of the hardwood land is alder whereas in Oregon it is just 50%. Maple, cottonwood and oak together account for 11-12% of the area in both states. In Washington other hardwoods represent only 4% of the area while in Oregon they represent 39%. This reflects the increasing diversity of hardwood species as one travels south from the Canadian border to California.

Growing Stock Volume

Growing stock refers to the cubic volume of live trees between the stump and a 4 inch top or to the point of limb dominance. The total volume of hardwood growing stock is 11954 million cubic feet of which 49% is found in Oregon and 51% in Washington (Table 2). The greater prevalence of pure, well-stocked alder stands in Washington probably explains why Washington's share of growing stock exceeds its share of the land base.

Table 2. The Hardwood Growing Stock Volume in Western Oregon and Washington

Growing Stock Volume: 11954 million cubic feet of which Oregon = 49%, Washington = 51%

A. Distribution by owner class, %

	OR	WA	Combined
Industry	35	38	37
Other private	30	42	36
Total private	65	80	73
USFS	14	2	8
BLM	11	--	5
Other public	10	18	14
Total public	35	20	27
	100	100	100

B. Distribution by species, %

	OR	WA	Combined
Red alder	52	77	65
Bigleaf maple	16	15	15
Oregon white oak	5	--	3
Black cottonwood	--	5	3
Others	27	3	14
	100	100	100

Source: Bassett & Oswald 1981a, 1981b, 1982; Gedney, Bassett & Mei 1986a, 1986b, 1987; Bassett 1979; Mei 1979; Jacobs 1978.

The growing stock distribution among owners is similar to that for land ownership except that industry and public agencies tend to have slightly higher percentages and non-industrial private owners have somewhat lower percentages. These differences are due to the combined effect of differences in age, site and stocking. The distribution among species is dominated by red alder (65%) and bigleaf maple (15%). The differences between states reflect the species diversity mentioned previously. The references from which these data were gathered suggest that almost 25% of the growing stock is in trees 17" dbh and larger.

Net Annual Growth

Net annual growth of the hardwood growing stock is estimated to be 406 million cubic feet (Table 3). In general, the distribution among owners and species is very similar to that for growing stock.

Table 3. The Hardwood Net Annual Growth of Growing Stock in Western Oregon and Washington.

Net annual growth: 406 million cubic feet
of which Oregon = 43%

BLM	11	--	4
Other public	12	19	16
Total public	29	20	23
	100	100	100

B. Distribution by species, %

	OR	WA	Combined
Red alder	58	79	70
Bigleaf maple	13	12	13
Oregon white oak	3	--	1
Black cottonwood	--	6	4
Others	26	3	12
	100	100	100

Source: Bassett & Oswald 1981a, 1981b, 1982; Gedney, Bassett & Mei 1986a, 1986b, 1987; Bassett 1979; Mei 1979; Jacobs 1978.

The sawtimber component of the inventory has a net annual growth of 1.6 billion board feet International 1/4 inch log scale which translates into 1.4 billion board feet Scribner (assuming 860 BF Scribner per MBF International).

PNW HARDWOOD LOGS: HARVEST AND EXPORT

Log Harvest

Annual harvest statistics are only available from the State of Washington (Table 4, col. 1). Counterpart statistics for Oregon are not available although an average annual harvest of 103 million board feet between 1973 and 1976 was reported by one source (Poppino and Gedney 1984). Other sources of information are periodic mill surveys conducted in both states which show the consumption of logs by mill type (Tables 5-6).

This survey information suggests the following distribution of log consumption by mills:

	% log consumption by				
	Sawmills	Veneer/Plywood	Export	Pulp	Total
Washington	84	6	1	9	100
Oregon	67	23	--	10	100

This distribution excludes chips derived from roundwood by independent chippers which are subsequently delivered to pulpmills. Generally, it appears as if the quantity of logs reported as delivered to sawmill, veneer, pulp or export markets is less than the reported harvest. However the difference may be explained by the quantities of logs that are chipped by mobile or stationary whole log chipping operations which would deliver chips rather than roundwood.

The available data suggest that the overall harvest of hardwoods has roughly doubled and that Oregon's harvest is roughly one-third that of Washington. The current total harvest appears to be on the order of 400 million board feet Scribner. The information presented probably underestimates total removals. These removals would include hardwood volumes not salvaged during conversion programs, cutting of firewood, land clearing in suburbs, etc. There is no information to indicate the overall size of these removals. A 1985 survey estimated firewood use to be 228,000 cords (Beachy and McMahon, 1987). Combining this with production levels of lumber, veneer,and chips they applied conversion factors to estimate the 1985 harvest at 573 million board feet. This is about 200 million board feet greater than the sum of the harvest values shown in Table 4. It would seem that the firewood component and chipping operations probably account for this differential.

Table 4. PNW Hardwood Harvest and Mill Consumption of Roundwood.

	Washington			Oregon		
		Consumption[2]			Consumption[4]	
	Harvest[1] MMBF Scribner	Logs MMBF Scribner	Chips BDT	Harvest MMBF Scribner	Logs MMBF Scribner	Chips BDT
1975	157					
1976	222	195	313,417	103[3]	66	NA
1977	210					
1978	195	227	4,068			
1979	196					
1980	289	228	58,273			
1981	234					
1982	242	183	88,076		50[4]	NA
1983	258					
1984	304	244	310,337			
1985	276				98[4]	NA
1986		240	185,355			

[1]Wash. State Dept. Nat. Resources, Timber Harvest Report, annual

[2]Table 5

[3]Poppino & Gedney 1984

[4]Table 6

Table 5. Washington Hardwood Log Consumption.

Volumes shown are MBF Scribner, except as noted

	Sawmill	Veneer/Plywood	Pulp Logs (see note)	Export Logs	TOTAL LOGS	Chips (B.D. tons) (see note)
1976						
Hardwood Volume	137,621	7,240	48,612	1,304	194,777	313,417
% of total WA HW	71	4	25	1	100	NA
WA all species	3,000,977	645,535	545,152	2,116,012	6,640 ,393	5,373,719
HW % all spec	5	1	9	0	3	6
1978						
Hardwood Volume	184,247	14,559	25,548	2,263	226,617	4,068
% of total WA HW	81	6	11	1	100	NA
WA all species	3,133,952	674,200	270,364	2,596,961	6,934,879	4,946,625
HW % all spec.	6	2	9	0	3	0
1980						
Hardwood Volume	144,080	20,768	45,160	18,448	228,456	58,273
% of total WA HW	63	9	20	8	100	NA
WA all species	2,434,139	483,176	436,233	2,308,206	5,834,805	5,394,851
HW % all spec.	6	4	10	1	4	1
1982						
Hardwood Volume	146,668	9,040	22,944	4,541	183,193	88,076
% of total WA HW	80	5	13	2	100	NA
WA all species	2,128,285	331,878	511,893	2,134,349	5,219,493	5,183,443
HW % all spec.	7	3	4	0	4	2
1984						
Hardwood Volume	153,372	9,970	76,433	3,708	243,483	310,337
% of total WA HW	63	4	31	2	100	NA
WA all species	2,597,097	392,042	392,942	2,265,441	5,769,037	6,483,986
HW % all spec.	6	3	19	0	4	5
1986						
Hardwood Volume	201,963	14,824	21,225	2,100	240,112	185,355
% of total WA HW	84	6	9	1	100	NA
WA all species	2,790,396	429,450	412,688	2,167,936	5,913,637	1,990,287
HW % all spec.	7	3	5	0	4	9

NOTE: "Pulp Logs" are chipped AT the pulp mill. Chips" are derived from whole logs (not residue) AWAY FROM the pulp mill.

Source: 1976 - Bergvall, Bullington, & Gee 1977; 1978 - Bergvall, Gee & Minneman 1979; 1980 - Larsen, Gee 1981; 1982 - Larsen, Gee Bearden 1983; 1984 - Larsen, Berzaden 1986; 1986 - Larsen, Bearden 1988 Preliminary.

Table 6. Oregon Hardwood log consumption

Volumes shown are MBF Scribner, except as noted

	Sawmill	Veneer/Plywood	Pulp Logs	Export Logs	Logs	Non-Roundwood consumed by pulp &board mills[1] tons, dry wt.
1976						
Hardwood Volume	45,607	2981	16,450	458	65,496	NA
% of total OR HW	70	5	25	1	100	
OR all species	5,404,356	3,305,705	71,000	494,554	9,338,604	7,296,498
HW % all species	1	0	23	0	1	
1982						
Hardwood Volume	33,509	10,684	4,598	898	49,689	NA
% of total OR HW	67	22	9	2	100	
OR all species	3,410,855	2,034,956	76,654	398,169	5,960,597	5,682,959
HW % all species	1	1	6	0	1	
1985						
Hardwood Volume	65,349	22,865	10,060	0	98,274	NA
% of total OR HW	67	23	10	0	100	
OR all species	4,987,341	2,484,395	70,198	694,688	8,271,856	6,761,218
HW % all species	1	1	14	0	1	

[1]Mill residues plus roundwood converted to chips at chipping mills.

Source: Howard & Hiserote 1978; Howard 1984; Howard & Ward 1988.

While the data suggest that harvests are less than 1/2 of annual growth, the true relationship may be considerably different when one considers total removals and includes the restrictions on availability that will be discussed later in this report. Table 7 presents recent information on average hardwood log prices. One can estimate the total delivered value of hardwood logs by combining the proportions of sawlogs and other logs in the harvest with average price assumptions of $175/MBF and $100/MBF respectively. Comparison of log consumption by sawmills, veneer/plywood, and exports for 1985 in Oregon and 1986 in Washington suggests that these logs comprised 54% of the harvest; the remaining 46% went to pulp or chipping facilities. The resulting weighted average delivered log price is $140.00. Assuming the 1985 harvest estimate of 573 million BF and deducting the 1985 hardwood log export volume (next section) indicates a domestic hardwood roundwood market of approximately $80 million.

I. Red Alder Sawlogs			
11/84	156	170	183
2/85	143	169	172
9/85	154	158	159
1/86	152	156	166
4/86	152	157	169
9/86	152	151	171
II. Bigleaf Maple Sawlogs			
9/84	130	80	130
1/85	140	--	132
9/85	140	--	128
1/86	140	100	140
5/86	146	--	140
9/86	140	--	137
III. Black Cottonwood Sawlogs			
11/84	111	--	- -
2/85	149	--	- -
10/85	111	--	--
1/86	111	--	--
5/86	--	--	--
9/86	111	--	--
Average Prices Paid by Mills for Hardwood Pulpwood, Delivered			
9/84	--	85	110
1/85	--	88	112
9/85	--	89	108
1/86	--	89	123
5/86	--	96	114
9/86	--	102	109

Source: WA Agricultural Statistics Service. Forest Products Price Report. Published bimonthly.

Table 7. Hardwood Log Prices (Continued)

B. Average prices $/MBF Scribner Paid by Mills for Delivered Hardwoods

RED ALDER	Willamette Valley	Wash Coast				Puget Sound		
		6"-7"	8"-9"	10"-11"	>12"	<9"	10-11"	>12"
1/86	180-200	--	--	--	--	130	175	190
3/86	190-230	--	--	--	--	130	175	190
5/86	200-235	--	--	--	--	130	175	190
7/86	200-250	--	--	--	--	130	175	190
9/86	200-250	--	--	--	--	130	175	190
12/86	200-250	--	--	--	--	130	180	190
2/87	220-250	115	185	215	225	130	180	195

BIGLEAF MAPLE	Willamette Valley	Puget Sound	Willamette Valley	
			Oak	Ash/chinquapin
1/86	120	--	190	--
3/86	150	--	210-225	--
5/86	150-160	--	210-225	180
7/86	150-160	140	210-225	180
9/86	150-160	140	210-225	180
12/86	150-160	140	210-225	180
2/87	150-160	140	210-225	180

RED ALDER PULP LOGS	$/ton		
	Willamette Valley	Columbia River	Puget Sound
1/86	--	18	--
3/86	--	18	--
5/86	--	18	--
7/86	--	18	--
9/86	--	18	--
12/86	--	18	--
2/87	18-19	18	18

Source: Gruenfeld 1986-87.

Log Exports

Between 1976 and 1986, exports of hardwood logs from the Seattle, Columbia-Snake (Portland) and San Francisco customs districts more than doubled in volume from 4.6 to 9.5 million BF Scribner, while value more than tripled from $3 to $10 million (Table 8). About 40% of these exports were to Japan. In 1984/85 hardwood log exports from these customs districts averaged about $5 million. Combined with the value of log deliveries to domestic mills, the total value of the log harvest is approximately $85 million. Hardwood logs were also exported from Southern California customs districts and from British Columbia (2.6 million BF BC log scale in 1986) (Warren, 1987). Unlike U.S. hardwood log shipments, BC hardwood log exports are primarily (76%) to the Peoples Republic of China.

Table 8. Volume & Value of PNW Hardwood Log Exports

	Volume MBF Scribner	Value 000,$
1976	4,645	3,023
1977	4,320	4,957
1978	4,209	6,370
1979	4,210	5,686
1980	9,752	8,179
1981	4,538	5,066
1982	4,746	4,486
1983	5,057	3,028
1984	6,757	5,403
1985	5,348	5,439
1986	9,598	10,013

Source: Warren 1987.

Although hardwood log exports are growing, several factors may favor manufactured products over logs.

- compared to conifers, hardwood logs are often smaller in diameter, shorter length, and more crooked reducing efficient vessel utilization.
- red alder logs may cause problems in storage and shipping due to relatively poor durability.
- unlike conifers, there may be a better match between foreign and U.S. specifications for processed lumber, particularly for furniture. Foreign buyers may prefer to obtain lumber grades best suited to their needs rather than buy and process logs that yield a mix of grades less suited to their cuttings.

The principal advantages to hardwood log transactions may be avoidance of tariffs and an ability to obtain high overrun from long hardwood logs scaled in Scribner. The foreign buyer may be more efficient in sawing, recover smaller sizes, edge-glue, etc. and thereby obtain relatively higher yields than would a U.S. mill. This high recovery may allow him to bid relatively higher log prices than do domestic mills.

PRIMARY PRODUCTS

Northwest hardwoods are processed into lumber, veneer and chips, which are in turn manufactured into furniture, cabinets, pallets, pulp and paper, and plywood. Most of the production is based on red alder. Table 9 summarizes Pacific Northwest hardwood utilization patterns for 1977 and 1985.

Hardwood Lumber

U.S. Hardwood Lumber Market The traditional domestic demand for U.S. hardwood products has suffered, as more and more American furniture retailers have featured pieces crafted offshore (Araman, 1986). The domestic markets that remain favor red and white oak, which have been in fashion among the U.S. furniture-buying public in recent decades. While there is no direct evidence that this trend is drastically abating, "there is now a strong interest in cherry, and I expect a stronger interest in other American hardwood species like hickory, ash and maple" (Losser, 1987). Alder falls into the "cherry" or "fruitwood" category for purposes of marketing to domestic furniture concerns, and this look appears to be gaining in popularity (Behm, 1984; Curtis, 1987). Table 10 presents hardwood lumber production and trade data and shows that while total west coast lumber production and total U.S. hardwood production have been relatively flat, production of PNW hardwoods has doubled, representing increasing shares of regional and national totals. It also shows strong overall growth in hardwood lumber exports.

Table 9. Pacific Northwest Hardwood Use: 1977 vs. 1985.

End Use	(Percent of Total Value) 1977	1985
Fine Furniture	34	19
Upholstered Furniture		20
Institutional Furniture		3
Cabinets	20	18
Chips	21	17
Pallets		20
Plywood		2
Other	25*	1
Total Value (Thousand nominal $)	$65,468	$97,986

*In 1977, "Other" included upholstered and institutional furniture.
Source: Cunningham & McMahon 1978; Beachy & McMahon 1987.

Table 10. Hardwood Lumber Production and Trade.

All Values in Million Board Feet Unless Indicated.

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
HW Lumber Production, Coast Region, WA and OR	128	131	165	179	162	158	156	179	229	229	270
Total Lumber Production, Coast Region, WA and OR	8,322	8,796	8,845	8,427	6,815	6,270	5,743	7,934	8,329	8,062	9,412
HW Production as a Percent of Total Coast Region	1.5%	1.5%	1.9%	2.1%	2.4%	2.5%	2.7%	2.3%	2.7%	2.8%	2.9%
U.S. HW Lumber Production	6,417	6,680	6,997	7,294	7,058	6,194	5,062	5,644	6,262	6,031	6,086
Coast HW Production as a Percent of U.S. HW Production	2.0%	2.0%	2.4%	2.5%	2.3%	2.6%	3.1%	3.2%	3.7%	3.8%	4.4%
U.S. HW Lumber Export Including Ties	241	238	299	361	487	479	386	514	527	427	549
U.S. HW Lumber Imports Excluding Ties	284	334	361	376	293	291	211	260	328	363	347
U.S. HW Lumber Imports from Canada	83	82	97	87	73	77	77	77	91	104	108

Source: Western Wood Products Association, 1986.

PNW Hardwood Lumber Manufacturing Practices Hardwood lumber manufacture in the PNW differs in some ways from practices elsewhere in the U.S. Unlike eastern mills which often process logs up to 16 feet, PNW hardwood lumber is normally manufactured from 8-12 foot logs PNW lumber is normally kiln dried, surfaced and then graded from the best face according to the west coast hardwood lumber grading rules (Fye and Briggs, 1978). In contrast, NHLA Standard Hardwood Cutting Grades for other hardwood species are applied to the poorer face. Many Eastern may sell rough and/or green lumber whereas, in the PNW, the mill bears the risk and costs of drying degrade. In addition to these grades, a variety of proprietary grades have developed between individual mills and their customers. It is often argued that hardwood manufacturers suffer compared to softwood lumber producers when cutting similar size logs. Reasons behind this are

- softwood producers can take advantage of a larger differential between the nominal lumber dimensions used to tally volume for commerce and the actual dimensions required. For example, a kiln-dried, surfaced 2 x 4 need only be 1.5 x 3.5 inches in size to meet these specifications. Softwood mills generally can set green target sizes on cutting machines well under the nominal sizes. In contrast, hardwood producers usually manufacture lumber where the difference between nominal and actual sizes is much smaller if not eliminated. Thus, hardwood green target sizes on machinery often exceed nominal sizes. For example, 4/4 red alder is sawn to 1 3/16" green, and 80% of this production is then dried and surfaced to 15/16' (Nielson, 1977; Remington, 1978; McGillivray, 1981b).

- Softwood producers often cut lumber 2 inches thick or thicker while hardwood manufacturers often cut thinner stock. Consequently, hardwood producers make more sawcuts and sawdust from a log.

Counterarguments to these factors are:

- softwood manufacturers must edge lumber into widths that are in 2 inch (nominal) increments while hardwood producers edge to random widths. In part, this makes up for the nominal vs. actual thickness disadvantage (Remington, 1978).

- softwood producers aiming at structural markets, process log lengths from 8 feet to 16-24 feet. The interaction of edging practices and taper reduces recovery from longer logs. PNW hardwood lumber mills generally process 8, 10 and 12 foot lengths. In part, this is due to the sweep and crook that is often encountered in hardwoods. However the interaction of random width edging and short logs, presumably reduces the effect of taper and increases recovery.

At this writing, the US Forest Service Pacific Northwest Research Station is analyzing data from a recent alder sawmill recovery study. The results of this study should help to quantify the volume and grade recovery relationships discussed above. There are no known recovery data for other PNW hardwoods.

Production of PNW Hardwood Lumber Small sawmills (less than 40 MBF/shift) have traditionally dominated this industry, although the trend is toward larger operations. For example, the average capacity per shift rose 45% between 1977 and 1985 (Beachy and McMahon, 1987).

There is also an indication that larger corporations are becoming interested in PNW hardwood lumber. In a market increasingly focused on international shipments, the participation of companies with the resources to develop offshore relationships may be a positive trend for the industry as a whole. PNW hardwood lumber production doubled between 1976 and 1986 (Table 10). Its role also doubled as a percentage of the overall PNW lumber industry and as a portion of total U.S. hardwood lumber production. The 1977 survey of the hardwood industry (Cunningham and McMahon 1978) reported production 14 million BF higher than shown in Table 10 while the 1985 survey obtained essentially the same production as shown (Beachy and McMahon, 1987).

The higher quality hardwood lumber is primarily used for furniture, the demand for which is linked to housing markets. Low interest rates and high rates of new construction generate demand for new furnishings when new homes are purchased. In addition, more frequent home changing during good home buying periods also stimulates demand for new furniture. Some of these cycles are apparent in Figure 1, which compares the trends in PNW softwood and hardwood lumber production.

Average prices and annual sales value of this hardwood lumber production are unavailable except for the 1977 and 1985 surveys which reported domestic sawmill sales of $65 million and $98 million respectively (Table 9). Export sales were not separated or were insignificant in 1977 and were reported as $3 million in 1985. Domestic sales include lumber as well as sales of chip residues and other by-products. Adjusting for these suggests lumber sales of $44 million in 1977 and $75 million plus $3 million export in 1985. About 75% of the 1985 domestic sales were to furniture and cabinets and the remainder to pallets (Beachy and McMahon 1987). Division of sales by reported lumber production suggests average lumber values of $300/MBF and $340/MBF respectively in 1977 and 1985.

Exports of PNW Hardwood Lumber Over the past ten years, the U.S. hardwood lumber industry has enjoyed dramatic and steady increases in levels of export to Japan (Japan Lumber Journal, 1985, 1987). 1986 trade value estimates range from $45.3 million, F.A.S. (USDA Foreign Agricultural Service, 1987) to $54.0 million, delivered (using 1986 data in **Japan Lumber Journal** and a 1986 average exchange rate of 170 ¥/$). Much of this increase in volume has involved red alder, along with lesser amounts of yellow-poplar, black cherry, and cottonwood (Araman, 1986). Unlike Taiwanese manufacturers who cater to the American preference for oak Japanese furniture makers are building pieces for their domestic market. The tastes of this clientele tend toward those woods which are reminiscent of domestic Japanese species. "Light-colored, fine-grained hardwoods that can be stained or given a natural finish...include red alder, black cherry, cottonwood and maple..." (Araman, 1986). Prices are good, with alder Selects fetching in excess of a thousand dollars per thousand board feet (Table 11).

There are no PNW agencies or trade associations that track exports of PNW hardwood lumber. The only information collected from producers is the estimated $3 million of export lumber sales in 1985 (Beachy and McMahon, 1987). U.S. Department of Commerce statistics on hardwood product exports are difficult to interpret for PNW species (Appendix II). The dominant species, red alder, was not separately identified until January 1987 and previously was a component of a category labelled "unspecified species" (codes 202.4370, rough and 202.4375, dressed). Beginning in 1987, a new code 202.4371 specifically identifies "western red alder, rough lumber." However, dressed alder, the dominant form of production is still in the unspecified species grouping. Other species, such as PNW maple, oaks and ash are likely classified with similar Eastern species groups. Records of actual shipping documents which show the shipper, shipping line, destination, species and quantity are available on microfiche but searching through this data is a rather tedious task. This data is also in computerized form on a small number of commercial data bases. Because of expense we did not attempt to use these services. Additional information is sometimes available from agencies in purchasing countries. The PNW hardwood lumber export estimates given in this paper reflect our best judgement of data from a variety of sources and are considerably larger than the $3 million estimate reported in 1985. We believe that there are two important factors contributing to the difference.

- in the survey, some producers may not have reported exports separately from domestic sales for proprietary or other reasons.
- some producers may have been unaware that sales to a domestic organization were in turn exported. Examination of shipping documents on U.S. Department of Commerce microfiche shows that many red alder shipments went through intermediaries prior to export.

Focusing on the U.S. Commerce category of unspecified species from PNW ports, Table 12 shows that this category has grown from 9 to 38 million BF and from $4 to $25 million since 1978.

Table 11. Prices Paid by Japanese Buyers for Red Alder Lumber (Select & Better 4/4 x 4 in. & wider 6 ft & longer 70% F.A.S.)

Date	¥/cum[1]	Exchange Rate ¥/$[2]	$/MBF[3]
Feb. 26, 1986	85,000	193.53	1,036.47
March 12, 1986	85,000	180.21	1,113.07
May 13, 1986	82,000	167.08	1,158.17
May 27, 1986	75,000	167.08	1,059.30
June 11, 1986	73,000	169.29	1,017.60
June 24, 1986	72,000	169.29	1,003.66
July 8, 1986	72,000	163.17	1,041.30
July 22, 1986	70,000	163.17	1,012.38
Aug 12, 1986	65,000	155.04	989.36
Aug 26, 1986	65,000	155.04	989.36
Sept 9, 1986	65,000	154.66	991.79
Sept 24, 1986	65,000	154.66	991.79
Oct 14, 1986	67,000	154.23	1,025.16
Oct. 28, 1986	68,000	154.23	1,040.46
Nov. 11, 1986	68,000	160.34	1,000.81
Nov. 26, 1986	70,000	160.34	1,030.24
Dec. 10, 1986	70,000	162.83	1,014.49
Dec. 23, 1986	72,000	162.83	1,043.48
Jan. 12, 1987	72,000	159.01	1,068.54
Jan 27, 1987	72,000	159.01	1,068.54
Feb. 11, 1987	72,000	152.07	1,117.31
Feb. 24, 1987	72,000	152.07	1,117.31
March 11, 1987	72,000	153.60	1,106.18
March 25, 1987	73,000	153.60	1,121.54
April 8, 1987	75,000	142.38	1,243.07
April 21, 1987	75,000	142.38	1,243.07
May 13, 1987	76,000	142.38	1,259.65

[1]Japan Lumber Reports, 1986-1987.

[2]Japan Lumber Journal, 1987.

[3]Divide $/cum by 35.313 cu ft/cum, then divide by 12 BF/cu ft, and multiply by 1000 BF/MBF.

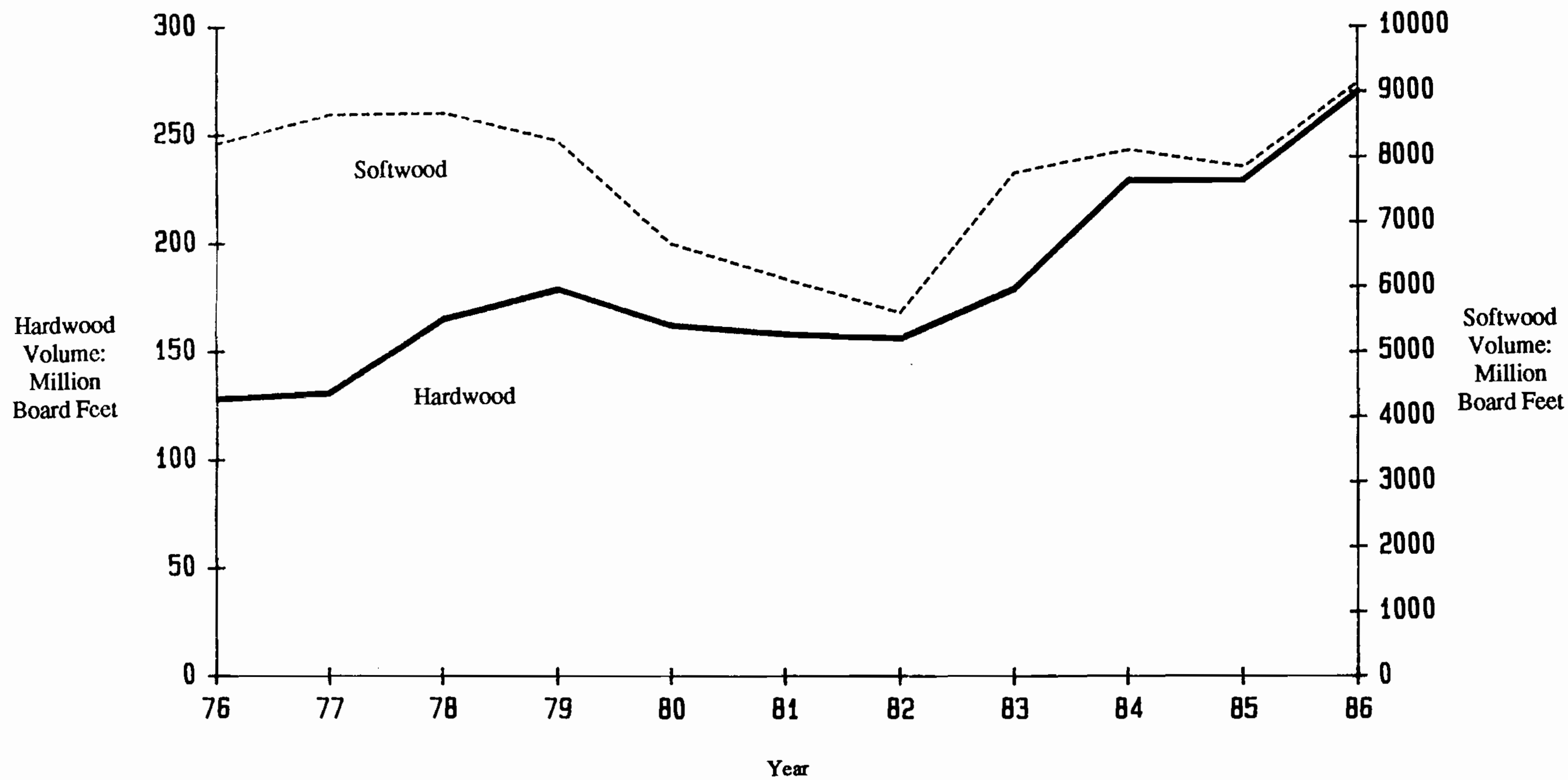

Figure 1. Coast Region, Washington & Oregon;Hardwood versus Softwood Lumber Production. (Source: Table 10)

Table 12. Exports of Hardwood Lumber (unspecified species) from the Pacific Northwest.

A. Volume, MBF	To all countries			To Japan		
	rough	dressed	total	rough	dressed	total
1978	5,006	4,034	9,040	53	3	56
1979	4,720	5,599	10,319	411	49	460
1980	6,626	4,082	10,708	635	585	1,220
1981	7,972	6,974	14,946	878	883	1,761
1982	7,137	5,663	12,800	1,672	1,294	2,966
1983	9,428	12,447	21,875	3,769	7,868	11,637
1984	9,860	20,595	30,455	5,799	17,201	23,000
1985	8,646	21,078	29,724	5,537	18,988	24,525
1986	7,993	30,298	38,291	3,332	26,962	30,294
B. Value, $000	To all countries			To Japan		
	rough	dressed	total	rough	dressed	total
1978	2,173	1,778	3,901	33	2	35
1979	3,327	3,015	6,342	487	33	520
1980	5,123	1,995	7,118	405	268	673
1981	6,585	2,654	9,529	653	476	1,129
1982	5,767	1,982	7,749	1,297	734	2,031
1983	7,418	6,535	13,953	2,779	4,797	7,576
1984	7,633	1,2902	20,535	4,360	11,747	16,107
1985	6,788	12,262	19,050	4,214	11,491	15,705
1986	6,332	19,018	25,350	2,482	17,851	20,333

Source: U.S. Dept. Commerce (see Appendix II).

There has been a strong shift away from rough to dressed lumber with an increasing share of these categories being exported to Japan. In 85/86 Japan imported 53% of the volume and 51% of the value of rough lumber of unspecified species exported from PNW ports. During the same years, Japan imported 90% of the volume and 94% of the value of dressed lumber of unspecified species from PNW ports. According to Araman (1986), 2/3 of this lumber from these ports to Japan is red alder. Applying this percentage yields the following estimates of Japan's imports of red alder.

	1985		1986	
	million $	MMBF	million $	MMBF
rough	2.1	2.7	1.2	1.7
dressed	7.6	12.7	11.9	18.0
	9.7	15.4	13.1	19.7

These data suggest that lumber exports were considerably higher than the survey estimate. It should be pointed out that this tabulation excludes all PNW species except red alder, it excludes exports of all PNW species including alder that exited non-PNW ports, and it excludes exports to all countries except Japan. In addition to red alder, it has been reported that Oregon white oak, Oregon white ash and bigleaf maple are being exported to Korea (Govett et al, 1987)) and the authors have observed bigleaf maple destined for Europe and shipments of PNW species to Taiwan. Since non-PNW ports may include larger portions of non-PNW species in these unspecified species commerce codes, there is no reasonable way to estimate the component due to PNW species. However, the new code for rough red alder that began in 1987 provides some hints as to activity from other ports and to other countries. We examined U.S. Department of Commerce microfiche records for rough red alder (code 202.4371) from January to August 1987 and tabulated shipments according to port and destination. We found numerous shipments to Canada and numerous shipments from non-PNW customs districts. For example, there were shipments from Philadelphia, Baltimore, Houston, New Orleans, Los Angeles, etc. There was also a great diversity of destination countries. Table 13 presents a summary of the data from all ports and shows the wide diversity of rough alder shipments and that European countries presently account for 50%. Simple pro-rationing suggests that 1987 shipments of rough alder will total about 5 million BF and $4 million. Combining this information on rough alder with the previous tabulation for Japan increases the 85/86 export value to approximately $12-16 million and 18-23 million BF. This estimate still excludes species other than alder and excludes dressed alder exported from non-PNW ports. Considering these omissions, we believe the average level of exports in 85/86 was on the order of $20 million and 25 million BF. We suspect that a substantial portion of the alder exports to Canada shown in Table 13 are subsequently re-exported to Asia and Europe. For example, BC hardwood lumber exports have fluctuated between 2 and 5 million BF per year, with shipments primarily to Japan and the U.S. (Warren, 1987). In 1982 and 1984 exports exceeded 9 million BF.These two years show unusually large shipments to the People's Republic of China.

Table 13. Exports of Rough Red Alder for 1987

	Region				
Jan-Aug	Canada	Europe	Asia	Other	Total
MBF	385	1662	1079	251	3377
$1000	333	1278	722	202	2535
%MBF	11.4	49.2	32.0	7.4	
% Value	13.1	50.4	28.5	8.0	
Ave $/MBF	865	769	669	805	751
Prorated 1987					
MBF	577	2493	1618	376	5065
$1000	500	1917	1083	303	3802
		UK	Japan	Saudi Arabia	
		Belgium	China	Barbados	
		France	Korea	Trinidad	
		Italy	Taiwan	Dominican	
		Netherlands		Republic	
		F.R. Germany		Mexico	
		Spain			
		Denmark			

Source: U.S. Department of Commerce microfiche, code 202.4371.

Combining export and domestic PNW hardwood lumber sales components is difficult, although it is obvious that it must exceed the $75 million domestic sales plus $3 million export sales reported for 1985 (Section 5.1.3). We estimated total sales by deducting the estimated export volume (25 million BF) from the total production (229 million BF) to estimate actual domestic sales. Multiplying by an average price of 340/MBF yields about $70 million. Next, add the estimated export sales of $20 million to get atotal of $90 million. Although this may be an oversimplification it suggests that approximately 10% of the annual lumber production and 20% of the sales value is due to the export market.

Veneer

PNW Hardwood Veneer Manufacturing Practices Alder veneer recovery is said to range between 1.8 and 2.7 SqFt (3/8" basis) per BF Scribner log scale, with recovery improvements resulting from steamed bolts, thinner veneer, and use of logs larger the the 9.4" average DIB (McGillivray, 1981b). The U.S. Forest Service Pacific Northwest Research Station conducted a veneer recovery study as a companion to the alder lumber study mentioned in the previous section. Forthcoming reports on this study will provide valuable current data on veneer recovery. There is no published information regarding veneer recovery from other species. Red alder has not been a preferred species for veneer production because of small diameters, crooked logs, knot size and frequency, a tendency to check or split, and wet spots which lead to blows (McGuane, 1987). In addition, when harvested in early spring, logs contain excess sap which causes sheets of veneer to adhere tenaciously to one another (Rucker, 1987). Given the relatively small diameter of hard-wood logs, one wonders how the new spindleless lathe (Brady 1987) technology would affect the economics of peeling PNW hardwoods. In addition to red alder, black cottonwood is often peeled into veneer. It is most commonly used as core stock in the production of softwood plywoods. Our research turned up little information on veneer production from other species. There are no technical reasons why veneer could not be produced from several and some would make attractive decorative veneers. A combination of a lack of appropriate processing capabilities, difficulties of obtaining supplies of these less common species, and a lack of marketing may explain this.

Production of PNW Hardwood Veneer In 1985, production of veneer from PNW hardwoods was 18.2 MMSF (3/8" basis) representing sales of $2.2 million (Beachy and McMahon, 1987).

Exports of PNW Hardwood Veneer Our research suggests very little export activity based on veneers from PNW hardwoods. U.S. Department of Commerce Statistics (Appendix II) show large volumes of hardwood veneers departing from West Coast customs districts but available data indicates this is predominantly due to hardwoods from other regions sold by veneer merchants. Between 1978 and 1986 exports of hardwood veneer of unspecified species (Schedule B 240.0150) from PNW customs districs grew from 3 to 15 million square feet ($0.26 to $1.55 million). It is unclear, though likely, that a component of this may originate from PNW species. Japan has been a declining recipient of this category and presently represents only 5 percent. For the purposes of this report we assume that exports of veneer based on PNW species are negligible.

Hardwood Plywood Exports from PNW Ports Because of formidable competition from Southeast Asian sources of peeler logs, veneer, and finished plywood, U.S. penetration of world and Japanese hardwood plywood markets has been uneventful. Table 14 lists hardwood plywood exports from Northwest ports to Japan and to all countries. Total exports have declined and Japan has been a very small component. There is no information to suggest whether PNW species are a significant element of this hardwood plywood trade.

Chips

Production and Consumption of PNW Hardwood Chips Hardwood chips used by the pulp and paper industry develop from three main sources

- roundwood logs delivered to pulpmills which convert them to chips for processing.
- roundwood logs chipped by independent stationary or mobile chippers.
- chipped by-products from other hardwood industries, primarily sawmills.
- In the latter two situations, chips may be sold to domestic pulp mills or exported. Red alder is the primary species used for hardwood chips although other species, such as tanoak, and cotton-

woods, are used locally. Information on total production and value of hardwood chips used domestically or exported is difficult to use and interpret because of different material forms (roundwood, chips, mill residues) and different measurement systems used (Scribner and cubic roundwood volumes; units, BDT, etc. for chips and residues). The market for hardwood chips in the U.S. has grown substantially, as demand for items whose pulp furnish can well utilize a hardwood component - tissue, computer paper, and fine writing paper - has increased. As can be seen in Table 15, hardwood chips now account for 30% of pulpwood volume nationwide (up from 25% in 1977). In contrast, Pacific Northwest pulp mills utilize only 5-10% hardwood in their furnish. From a technological standpoint, Northwest pulp mills could easily consume more hardwood chips (Fay, 1987). These mills may increase hardwood consumption soon; they are finding that they need the quality attributes imparted by hardwoods in their products as they compete with products from eastern mills that utilize a greater proportion of hardwoods (Baack, 1988).

Table 14. Hardwood Plywood Exports from Washington and Oregon Ports

	Surface Measure (Thousand square feet)	
Year	To All Countries	To Japan
1975	10,493	14
1976	24,229	61
1977	17,673	162
1978	12,160	18
1979	9,962	108
1980	9,718	978
1981	18,645	13
1982	9,435	19
1983	16,541	16
1984	9,140	0
1985	9,874	755

Source: Warren, 1987.

In 1985, the pulp and paper industry in Washington and Oregon consumed 726,000 units of hardwood chips, while 315,000 units were exported (Beachy and McMahon, 1987). This information is consistent with hardwood pulplog and chip consumption data presented in Tables 5-6 and allowing for conversion of Scribner volume to chip measure and for the difference between BDT and BDU[1]

The 1987 production and use of PNW hardwood chips was

	BDU	%
Domestic	735,000	58
Export	535,000	42
Total	1,270,000	100

Source: Baack, 1988

Since a BDU represents approximately a cunit of solid wood, domestic use represents about 574,000 standard cord units (128 cu ft.) which is in reasonable agreement with Table 15.

Exports of PNW Hardwood Chips "There has been, and will continue to be, a shift in paper demand in Japanese markets away from those paper products which are softwood intensive toward other paper

1 For alder, we use 4.5 BF Scribner/CuFt and 100 cuft (one cunit) is approximately 1 BDU (McGillivray, 1981b reports 104 cuft = 1 BDU). In addition, a BDU weighs 2400 lb. while a BDT weighs 2204 lb, so 1 BDU yields 1.1 BDT.

Table 15. The Hardwood Component of West Coast and U.S. Pulpwood Consumption.

(Thousand Standard Cord Units: 1 Cord = 128 CuFt.)

Year/Month		—Hardwood/Total—		——Total U.S.——		——West *——	
		West*	U.S.	Softwood	Hardwood	Softwood	Hardwood
1977	1	5.42%	24.08%	4665	1480	1204	69
	2	5.72%	24.40%	4540	1465	1138	69
	3	5.66%	25.13%	4913	1649	1216	73
	4	6.46%	26.10%	4756	1680	1216	84
	5	5.19%	24.65%	4949	1619	1279	70
	6	5.74%	24.60%	4893	1596	1232	75
	7	6.27%	25.42%	4515	1539	1091	73
	8	5.76%	24.58%	4824	1572	1195	73
	9	6.02%	24.29%	4466	1433	1171	75
	10	7.34%	24.45%	4939	1598	1238	98
	11	5.70%	25.49%	4598	1573	1157	70
	12	5.73%	25.57%	4127	1418	1052	64
1986	1	5.87%	29.90%	5524	2356	1250	78
	2	6.09%	29.98%	5154	2207	1156	75
	3	5.75%	29.99%	5235	2243	1213	74
	4	6.24%	30.75%	5361	2381	1277	85
	5	5.03%	30.74%	5194	2305	1190	63
	6	8.63%	31.28%	5197	2366	1197	113
	7	9.63%	30.33%	5447	2371	1258	134
	8	9.99%	31.18%	5218	2364	1225	136
	9	10.48%	31.46%	5046	2316	1153	135
	10	9.22%	30.29%	5423	2356	1378	140
	11	12.93%	33.86%	5080	2601	1145	170
	12	8.35%	31.31%	5354	2441	1186	108
1987	1	9.52%	30.44%	5599	2450	1283	135
	2	8.69%	30.65%	5230	2311	1187	113
	3	8.81%	30.75%	5449	2420	1221	118
	4	5.43%	30.30%	5475	2380	1288	74

* West includes OR., WA., AK., ARIZ., CA., ID., and MT. However, OR. and WA. use about 35% each of this.
Source: American Pulpwood Assoc., (1977, 1986, 1987)

products, such as fine writing paper and copy paper, which require a greater percentage of hardwood fiber" (Schreuder, Anderson, 1987). Accordingly, hardwoods, which accounted for about 10% of total chip imports by Japan in 1965, now claim close to 50% of import volume (Schreuder, Anderson, 1987). Table 16 presents Japan's chip imports in 1986. In recent years, the U.S. share has been 5% of Japanese hardwood use, 14% of their hardwood imports, and 11% of U.S. all-species chip export to Japan (Japan Lumber Journal 1987, Amari, 1986). Imports of U.S. hardwood chip by Japan are shown in Table 17. Most of this material is red alder, which the Japanese consider "to be of good quality for bleached hardwood sulfate pulp" (Schreuder, Anderson, 1987), as well as for linerboard and kraft paper (Amari, 1986). The price paid for alder chips by Japan between 1977 and 1987 (Table 18) has often been higher than the Douglas fir chip price. The Japanese are always on the lookout for consistent, economical sources of supply - wishing to avoid another "chip shock" such as occurred in 1980 - and have developed alternatives to dependence on Pacific Northwest such as:

- A recent advance in pulping technology now allows the use of tropical hardwood species in fine writing paper manufacture (Japan Lumber Journal, May 20, 1985, p. 13).

- The Japanese pulp industry has developed "new techniques for utilizing small-sized hardwood logs and mill residues in the pulping process" which will allow more flexibility in the use of domestic thinnings and residue (Schreuder, Anderson 1987).

- Sources of eucalyptus chips including Australia, China, Brazil and a Japanese owned eucalyptus plantation in Papua New Guinea which supplies 40,000 tons year (57,000 cum/year) (Japan Lumber Journal June 20, 1985, p. 15).

Table 16. Japan's Sources of Imported Chips, 1986.

	000 BDU		
	Hardwood	Softwood	Total
U.S.	287	1,648	1,935
Canada	13	461	474
Australia	2,107	--	2,107
New Zealand	125	210	335
South Africa	351	--	351
USSR	37	200	237
Other	207	--	207
	3,127	2,605	5,732

Source: Baack 1988.

Table 17. Japanese Wood Chip Imports from the United States 1973-1986

Year	Softwood	Hardwood		Total
	000 m^3	000m^3	000 BDU[1]	000 m^3
	7,473	92	32	7,565
1974	8,338	343	121	8,681
1975	7,196	505	178	7,701
1976	8,092	529	187	8,621
1977	8,029	636	225	8,665
1978	6,905	352	124	7,257
1979	7,783	624	220	8,407
1980	7,299	788	278	8,087
1981	5,381	747	264	6,128
1982	4,790	505	198	5,295
1983	4,255	523	185	4,778
1984		NA		
1985		760	268	
1986		759	268	

[1] Multiply by 35.313 to get cu. ft, then divide by 100 to get approx. BDU.
Source: Amari, 1986, JLJ 1987

Table 18. Prices Paid by Japanese Buyers for Red Alder Chips.

Term of Contract: Year &	H = Half or Q = Quarter	Alder Price	D. Fir Price
1977		$56.00	$52.00
1978		$58.00	$51.00
1979	H1	$62.00	$51.00
1979	H2	$66.00	$55.00
1980	Q1	$86.00	$101.75
	Q2	$97.00	$137.50
	Q3	$94.00	$125.00
	Q4	$89.00	$105.00
1981	H1	$88.00	$101.00
	H2	$85.00	$101.75
1982	H1	$86.50	$102.50
	H2	$96.00	$96.00
1983	H1	$87.00	$84.50
	H2	$85.00	$77.00
1984	H1	$87.00	$78.00
	H2	$87.00	$80.90
1985	H1	$89.75	$84.80
	H2	$88.25	$81.40
1986	H1	$88.25	$79.40
	H2	$89.75	$77,40
1987	H1	$94.00	$77.40

Import Contract Price of Alder Chips Compared with Douglas Fir Chips; US$/BD ton, F.A.S., U.S. Port
Source Japan Lumber Journal, 1987.

The data in Table 17 were converted to BDU to make them comparable with the following tabulation of U.S. PNW Hardwood chip exports.

	BDU	$/BDU FOB Ship	Export Value $ million
1985	315,000[1]	89[2]	28.0
1986	287,000[2]	91[2]	26.1
1987	535,000[2]	95[2]	50.8

[1] Beachy and McMahon, 1987.
[2] Baack, 1988.

These statistics are in reasonable agreement with Japanese import statistics, given time lags between shipment and delivery and possible variations in conversion factors. Activity in 1988 and beyond is expected to rise sharply due to favorable exchange rates and increased use of hardwoods in the furnish of the Japanese pulp and paper industry. Given 1985 domestic and export chip quantities of 726,000 and 315,000 BDU and multiplying by the 1985 price of $89/BDU (which is assumed to be similar for both domestic and export purchases due to competition), we estimate total value of chips to be $92.6 million of which $28.0 million (30%) went into exports.

PNW HARDWOOD PRODUCTION AND EXPORT SUMMARY

Combining the estimates from the proceeding sections provides the following picture of the economic importance of PNW hardwoods in the mid 1980's.

- The value of logs delivered to domestic mills is approximately $80 million.
- Production and sales of products including export logs are about $190 million with the breakdown given in Table 19.
- Almost 30% of the $190 million sales of PNW hardwoods is based on exports.

Table 19. Summary of PNW Hardwood Products Sales, circa 1985/86.

A. Value, $ million

Product	Domestic	Export	Total
Logs	--	5	5
Lumber	70	20	90
Veneer	2	0	2
Chips	65	28	93
Total	137	53	190

B. Value % by product category

Product	Domestic	Export	Total
Logs	--	7	100
Lumber	78	22	100
Veneer	100	0	100
Chips	70	30	100
Total	72	28	100

C. Value % by domestic vs. export use

Product	Domestic	Export	Total
Logs	--	9	3
Lumber	51	38	47
Veneer	2	0	1
Chips	47	53	49
Total	100	100	100

If we assume that the harvest for industrial purposes is about 550 million BF, total product sales represents about $350 per MBF (Scribner) harvested. This average value can be related to the delivered log cost to estimate the value-added in log manufacture (Ringe and Hoover, 1987). Using a delivered hardwood log cost of $200/MBF yields a value-added in log manufacture of 75%. Since this delivered log cost is the price generally paid for high quality large logs, this calculated value-added is an underesimate. Using the average delivered log cost of $140 derived in the log harvest section yields a value-added in log manufacture of 150%. Since not all of our sales data represent F.O.B. mill conditions we believe the true value is within the range 75-150%. Compared to similar value-added calculations for Douglas fir of 3% for No. 1 Peelers and 32% to 52% for No. 3 sawlogs (Ringe and Hoover 1987) value-added in log manufacture from PNW hardwoods is apparently much higher. This may provide some justification to the belief that alder and other hardwoods are still undervalued in the stumpage paid to landowners, a situation that continues to foster the negative attitude and suppresses interest in managing hardwood stands.

PROBLEMS, ISSUES, AND OPPORTUNITIES

Resource Attitudes and Concerns

Attitudes Toward the Resource "In years past, alder was a weed to be cleared from the land so that some form of softwood could be encouraged to develop. The potential for harvesting alder was not even considered. We have poisoned and spent thousands of dollars to remove this species from our land, and yet it continues to grow and flourish." (Remington, 1978). Such has been the traditional attitude of foresters, land owners and government officials toward alder and other Northwest hardwoods. The attitudes of some toward Northwest hardwoods have changed in recent years. Increased interest particularly in red alder has been indicated by the emergence of two major conferences on the subject (Briggs, DeBell, Atkinson, 1978; Oregon State University, 1984). Oregon State University extension Service has also published a monograph describing when and how to manage for alder (Hibbs, 1986). However, the Oregon Forest Practice Rules, for instance, state that "Red alder or other hardwood species shall not be counted as acceptable species in stocking surveys of lands which have supported adequately stocked stands of Douglas-fir or other acceptable conifers, unless a prior alternate plan is approved by the State Forester" (Oregon State Dept. of Forestry, 1985). The 1982 Washington State Forest Practices Act acknowledges that a non-preferred species - such as any hardwood - may be appropriate in certain locations for one of three reasons (Wash. State Forest Practices Board, 1982):

- Site data indicates better potential production for the proposed species than the existing species.
- Control of forest insects or diseases.
- Greater economic return.

Popular attitudes toward these three points are briefly discussed below.

Improved Growth The presence of *Actinomycete Frankia* Sp. in the root nodules of red alder and the ability of this synergism to fix nitrogen in the soil are well documented (Atkinson, Hamilton, 1978; Miller, 1984). Pure alder stands produce 30 to 100 pounds per acre per year, [2] an amount well within the range of Douglas-fir nitrogen requirements (Miller, 1984). While some speak of planting alder along with Douglas-fir on nitrogen-deficient sites (Tarrant, 1978), others are skeptical about the practice except on sites with serious nitrogen deficiencies (Chambers, 1974), cautioning that "an adequate stocking of Douglas-fir in the final stand requires that the initial red alder component be minimal or be removed in an early liberation cut" (Miller, Murray, 1978).

Control of Disease One good reason for planting hardwoods in an area is that the presence of laminated root rot (*Phellinus a weirii)* makes successful establishment of Douglas-fir doubtful (Nelson, et al., 1978).

2 Smith (1984) reported estimated N_2 fixation rates as high as 600 pounds per acre for a 6 month period in greenhouse seedling samples.

Greater Economic Return. When the real discount rate exceeds 7%, a regime which includes short-rotation (28 year) alder sawlog production may be more profitable than repeated Douglas fir harvesting at 45-year intervals (DeBell, 1984). Attractive financial yields combined with growing demands for hardwood chips by PNW pulpmills have prompted interest in establishment of hardwood plantations. For example, James River Co. has established two experimental stations in Oregon to study the feasibility of short-rotation cottonwood (*Populus trichocarpa Torr. and Gray*) pulpwood cultivation, and a small production faculty has been started near one of the company's paper mills. Simpson Timber Co. is now establishing a eucalyptus plantation in Northern California as a pulpwood source.

Conversion to Conifers The Washington State Department of Natural Resources (WDNR). manages 157,430 acres of hardwood timberland, or about 8% of the total Washington State hardwood land base. 140,000 acres of this resource are slated for conversion to conifers within the next 30 years (Wash State Dept Natural Resources, 1983). The Department's reasoning is that both net annual growth and per acre value at rotation will be higher, if its land is used for conifer production. [3] Current WDNR projections call for between 67 and 115 million board feet of hardwood harvest from its lands annually for the next 30 years. In its Forest Land Management Program (FLMP), the Department states that it ". . . is anxious to develop markets for this wood" (Wash State Dept Natural Resources, 1983).

Similarly, the Oregon State Department of Forestry has identified 488,000 acres of hardwood which it intends to convert to conifer production (OR. State Dept. of Forestry, 1977). Approximately 80% of this land is identified as containing "dense hardwood greater than 20 feet tall," in other words, young stands that may be needed if the hardwood industry is to continue to prosper. If the predictions of Skog and Haynes (1987) are correct, public and private land owners with mandates to maximize revenues may wish to rethink their plans to convert lands from hardwoods to softwood production. These authors assert that recent technological advances in the way wood is utilized may bring about a rise in hardwood stumpage values of as much as 90%, while softwood timber may depreciate in value by 40% by the year 2000.

Logging Cost Harvesting hardwood timber presents some unique challenges. Alder in particular poses special technical, economic, and safety problems for loggers, in addition to the negative attitudes many woodsmen have developed concerning logging this species. According to Feddern (1978), "It takes a lot of convincing to change a production oriented logger to even think that there may be a profit in a hardwood species logging operation."

Some of the problems encountered in alder logging shows are (Feddern, 1978):

- Undergrowth is denser, making it more difficult to traverse slopes and to plan escape routes.
- Crowns are often unbalanced, or they lean out over steeper slopes, necessitating downhill fellng.[4]
- Yields are low, ranging from 2 to 20 MBF per acre.[5]

3 It should be noted that the WA State Forest Practices Act leaves both the WDNR and other land owners with some flexibility in responding to changing demand patterns; "Site-specific stocking prescriptions will allow a mix of species on a site. The Dept will be able to watch product trends and change stocking prescriptions accordingly to grow trees that will best fit the future markets." (Washington State Dept. Natural Resources, 1983).

4 A practice referred to as "lining" is described (McGaughey, 1987) in which a cable is fastened between the tree to be dropped and a small yarder on a nearby landing. While this procedure is costly, it does insure the direction of fall, making felling safer and yarding easier.

5 Chambers (1974) shows a range of yield values between 1,500 and 50,000 BF/acre. The average yield, however, for pure alder stands on WDNR lands is 12-14 MBF per acre. By contrast, Douglas-fir stands normally yield 45 MBF/acre on WDNR lands (Chambers, 1987).

- Sturdy stumps suitable for rigging guylines, tail holds, and corner blocks are often lacking in hardwood stands.
- Irregularly shaped pieces limit trucking capacity to about 3,500 BF per load (52,500 lb./load).[6]

At the lower elevations characteristic of hardwood sites, muddy conditions result in a shorter logging season (June to October). This in turn causes a summer log supply glut which is complicated by alder's tendency to decay during extended cold deck storage. Feddern quoted an average 1977 cost for felling, bucking, yarding, loading, and hauling of $100/MBF. When one adds in the effects of inflation, one sees that today's logger has a sizable investment in the log before it reaches the mill. By looking at Table 7, which shows the prices recently paid by mills for hardwood logs, one sees the economic limitations on hardwood logging operations. This, in turn, suggests relatively low residual stumpage values that may serve as a disincentive for managing or retaining hardwood stands. Low stumpage may perpetuate itself as agencies react to history by not developing hardwood sales or by not having hardwoods as a bid species in a mixed species sale. Hardwood operators find themselves unable to bid effectively and a vicious circle of undervaluation that reinforces bad attitudes is perpetuated. The U.S. Forest Service has been studying the problems associated with harvesting small trees. LeDoux (1985) examined six cable yarding systems for yarding Southern hardwoods. He simulated a hardwood logging operation and estimated the following stump to mill costs:

Stump to mill harvesting cost for a simulated Southern hardwood logging show.

Average DBH of trees cut	11.6	15.8
Trees/Acre cut	162	80
Volume cut (CuFt/Acre)	2,778	2,356
	Stump to mill logging cost	
$/Acre	1061.81	813.65
$/CuFt	0.38	0.35

Source: LeDoux, 1985.

Miyata, et al. (1986) described a yarding system which they tested on piece sizes up to 400 pounds. They found that a two-person crew could yard 1,000 CuFt per day on a 20% slope. Total capital cost was $10,000 or $3.00 per hour. This sort of research may favorably affect the future economics of logging Northwest hardwoods.

Resource Quantity and Availability There are two significant changes that may greatly alter the acreage and volume data presented in the section on the PNW hardwood resource. First, industry programs to cut maturing hardwood stands and replant to conifers were very extensive as were programs to eliminate hardwoods from young conifer plantations. Thus, the total area of lands in pure or mixed hardwood stands has undoubtedly been decreased. This may mean that there are relatively few acres of hardwood stands younger than 20 years in age. An unbalanced age class distribution could pose problems in the future. Second, environmental regulations that require buffer strips along streams could cause a large percentage of the better hardwood sites to be either unavailable or subject to more difficult, high cost logging procedures. The new inventories will shed some light on these issues and present a better picture of hardwood resource availability. Of particular interest will be the distribution of lands and volume by age class. Generally, alder stands are considered mature at 50 years age and begin to deteriorate above this age (Little, 1978).

6 The typical truckload of Douglas-fir contains about 5,000 BF.

Markets

While investigation of offshore markets and their potential was not an objective of this study, information for some was gathered and is briefly summarized in this section. As has been pointed out by many others, the key to success in foreign markets is to take the time to understand the foreign markets' mechanisms and needs, to put in the effort to produce what is desired in terms of size, quality, quantity and delivery and finally to be committed to the market through good times and bad.

Japan Japanese manufacturers have increasingly turned to outside sources for hardwoods, as their domestic forests could no longer sustain the harvest levels dictated by industrial demand (Japan Lumber-Journal 1987). North America is now in a good position to take advantage of opportunities in this market since supplies of tropical logs are becoming more difficult for Japan to obtain. Becoming familiar with end-use applications of various species and substitution opportuniies is an important step in understanding these markets. For example, Araman (1986) showed the following substitutions of U.S for Japanaese hardwoods.

Kaba (Japanese birch	Red Alder
Nara (Japanese oak)	Red/white oaks
Shina (Basswood)	Yellow poplar/cottonwood
Sen or tamo (White ash)	White ash

Some associations have also become involved in the international marketing effort. The National Forest Products Association (NFPA), for example, sent a delegation to Japan in 1985, and plans were made for the U.S. Hardwood Export Conference to open a Japan office (Japan Lumber Journal, 1985).

Since most Northwest firms dealing in hardwoods are relatively small and lack the resources necessary to mount an extensive international marketing campaign, it would seem advantageous that an umbrella association or state agency make initial contacts.[7] An extensive directory of Japanese associations and government agencies has been published (Japan Lumber Journal, 1983).

Taiwan Taiwan's 1986 imports of U.S. hardwood lumber amounted to $67 million, a five-fold increase from the 1982 level (USDA Foreign Agricultural Service, 1987). "Rising local labor costs and prices of imported Southeast Asian logs made importing U.S. hardwood more cost efficient in Taiwan." (USDA Foreign Agricultural Service, 1987). The burgeoning Taiwanese furniture industry is geared chiefly toward the U.S. furniture market, and, for this reason, oak is the wood of choice. However, "demand for maple, hickory, and cherry grew significantly in 1986" (USDA Foreign Agricultural Service, 1987), and users might well be persuaded to substitute alder for the more expensive cherry. One trade barrier to be overcome is the Taiwanese ad valorem import tariff. However, rates have recently been reduced as shown below:

TAIWAN AD VALOREM IMPORT TARIFF (Percent)

	Previous	Current
Finished lumber	20	5
Wood furniture	40	25

Source: USDA Foreign Agricultural Service, 1987.

7 A caveat is that inaction by Pacific Northwest concerns will invite encroachment into our Japanese market share by Eastern U.S. and Eastern European interests, who are already planning aggressive marketing initiatives (Ross, 1985; Losser, 1985; Ward, 1985).

South Korea As is the case with Taiwan, Korean manufacturers have been facing rising prices for tropical hardwoods, and U.S. material is increasingly being sought, although still on a modest scale. The National Forest Products Association (NFPA, 1985) believes this market has the potential of rapid growth by 1990, as shown below:

U.S. Hardwood exports to Korea ($ million).

	1978 actual	1984 actual	1990 projection
Hardwood logs	1.5	3.1	10.0
Hardwood lumber	--	1	20.0

In contrast to Japan, note the Korean tendency to purchase hardwood *logs* rather than lumber. The tariff system strongly encourages this behavior, with log duties running between 5 and 10%, while lumber and veneer are assessed for 20%. The NFPA is working with the government to ease tariff barriers, and, since Korean furniture manufacturers stand to benefit as much as U.S. lumber mills, the hopes are good for reductions. A wide array of Eastern hardwood species is imported from the U.S. in small quantities, both for furniture and musical instruments. Bigleaf maple would be a good candidate for Korean piano manufacture. Alder is not listed in the literature, but since Korea exports furniture to Japan, this species should be of interest to manufacturers aiming at that market. Although 7 major importers account for 98% of Korean hardwood imports, it is in the smaller shops that experiments with new woods are usually initiated. The cottage industry is supplied by "traders and middlemen, who should not be overlooked in U.S. promotional efforts, since they are often the channels by which new species are introduced." (Pacific Consultants Corp., 1986; USDA Foreign Agricultural Service, 1987).

India A National Forest Products Association (NFPA) delegation to India assessed the potential for trade with that country and observed that among "the best U.S. export prospects" for India are hardwood logs, hardwood lumber for doors and furniture, oak and maple flooring, and poplar (cottonwood) for matches (Ward, 1986).

Europe The USDA Foreign Agricultural Service reports that there is "renewed European interest in U.S. hardwood" (USDA Foreign Agricultural Service, 1987). This is also apparent from our data (Table 13) which shows that approximately half of the rough alder shipments were to Europe. U.S. exports of logs and lumber to selected E.E.C. countries are given in the following tabulation showing their relative importance:

U.S. exports of hardwood logs and lumber to France, Italy, the Netherlands, and the U.K. for three recent years.

	France	Italy	Netherlands	U.K.
	(in Thousands of Dollars)			
Hardwood Logs				
1984	1,611	5,732	1,678	1,748
1985	1,643	6,225	1,156	408
1986	1,686	5.044	1,033	498
Hardwood Lumber				
1984	7,444	15,567	10,174	15,997
1985	6,279	10,221	8,127	13,945
1986	6,611	16,028	10,277	24,230

Source: USDA Foreign Agricultural Service, 1987.

Utilization Opportunities

This study has focused on primary products such as logs, lumber, veneer, and chips. In this section, a few examples of new production methods and value-added approaches are briefly described. These are examples of well researched methods that are available for implementation.

The SDR Approach to Producing Hardwood Lumber Although the higher grades of alder lumber (Selects & #1 shop) command good prices, finding outlets for lower grades is often a problem. This material can be chipped or manufactured into pallet stock but another option is to produce stud grade lumber for housing. The Western Wood Products Association (WWPA) now accepts red alder in its "stud grade" (WWPA, 1979). The stud market could be attractive to alder mills for two reasons: 1) The actual wood volume needed to produce a nominal 2 x 4 stud is only about 70% of that needed to produce an 8/4 x 4" piece of #3 shop; 2) In some markets, studs will fetch a higher price per MBF than will #3 shop. Concern has been voiced about downgrade of alder studs caused by excessive warp. However, it has been determined that the saw, dry, and rip process (SDR) could all but eliminate the warp problem (Layton, 1982; Layton, Smith, Maeglin, 1986). This study asserted that "by live sawing full-width flitches, growth stresses are somewhat offset by drying stresses. Stresses are thereby balanced and restrained." A high-temperature drying schedule was also recommended by these researchers. Their evidence showed that SDR would virtually eliminate crook, while high-temperature drying would reduce twist. Results of the study indicated that SDR with high-temperature drying would increase red alder stud gross revenues by 25%.

There is also no reason why SDR could not be employed for manufacture of furniture lumber. In this case, a marketing effort may be needed to show furniture makers or plants cutting dimension stock that they and the sawmill could both get improved yields by agreeing to manufacture and purchase minimally edged, surfaced-dry SDR flitches. This may be an especially attractive way to process small to medium size logs quickly while maximizing potential yield.

Cutting standard-size blanks Gatchell (1987) states that "Differences in prices among hardwood lumber grades do not reflect the potential value of the lower grades for making furniture and cabinet parts." He goes on to explain that glued-up rough-dimension panels of specified lengths, widths, thicknesses and qualities called standard-size blanks can be cut from low-grade material in order to:

- Add value to the stock,
- Reduce shipping costs, and
- Free furniture makers from the added step of remanufacturing low-grade lumber into stock they can utilize.

By analyzing lumber orders from several furniture makers, a list of standard sizes was developed (Table 20) which would satisfy the majority of their needs (Araman et al., 1982). Gatchell (1987) also describes two process modifications - System 6 and the "gang-rip first option" - aimed at more efficient converting of smaller hardwood logs to standard-size blanks; 6 ft. bolts 8-12" in diameter can economically be utilized with this approach (Reynolds, Gatchell, 1979). Among organizations considering remanufacturing hardwoods for added value are Diamond Wood Products (Lilley, 1987) and the Quinalt Indian Tribe.

Oriented Strand Board (OSB) Made from Red Alder Wright (1986) explored the economic feasibility of building an oriented strand board (OSB) plant in Western Oregon based on alder. Her proposal called for a small plant producing 75 million SqFt/year (3/8" basis). She assumed that OSB would have the potential to gain 20% of the structural panel market - or 500 million SqFt/year - in the Western Region.[8] From this study, Wright drew the following conclusions:

- Clatsop, Columbia, and Tillamook Counties would be best suited for the plant because of a large resource, gentle slopes, and private ownership of the stumpage.
- Net present value (NPV) of the venture would be $1.6 million.
- Internal rate of return (IRR) would be 12.5%.

Table 20. Recommended Hardwood Blank Standard Sizes for Furniture and Cabinet Manufacturers. Dimensions in inches

Nominal thickness	Intended product finish thickness	Actual blank thickness	Blank lengths												
			Clear Quality/26-Inch Wide Blanks												
5/8	3/8	1/2	13	15	17	18	22	31	36	42					
3/4	1/2	5/8	14	17	19	22	25	29	31	35	41	47	58	86	
4/4	3/4	7/8	15	18	21	15	19	33	38	45	50	60	75	100	
1-1/4	1	1-1/8	15	18	21	25	29	33	38	45	50	60	75	100	
1-1/2	1-1/4	1-3/8	15	18	21	25	28	32	35	40	45	50	60	70	85
2	1-5/8	1-3/4	15	18	21	25	28	32	35	40	45	50	60	70	90
			Core Quality/26-Inch Wide Blanks												
1	3/4	7/8	15	18	21	23	26	29	34	40	50	60	70	95	
1-1/4	1	1-1/8	15	18	21	23	26	29	34	40	50	60	70	85	
			Sound Frame Quality (for upholstered frames)/20-Inch Wide Blanks												
1	3/4	7/8	13	17	19	22	24	27	28	33	44	54	70	80	100
1-1/4	1	1-1/8	15	18	20	23	25	28	33	45	55	65	80	90	100
1-1/2	1-1/4	1-3/8	14	18	21	24	28	31	34	40					
2	1-5/8	1-3/4	12	16	19	21	24	28	30	34					
			Sound Interior Quality (for case goods)/20-Inch Wide Blanks												
1	3/4	7/8	15	18	21	25	29	34	40	50	60	70	95		

Source: Araman et al., 1982.

Chances of a positive NPV would be 81%. Selling price is the variable most sensitive to change, followed by interest rate and capital cost. As interest rate drops, both the NPV and the demand for new housing should increase. As to the technical feasibility of producing OSB from alder, Maloney (1978) found that structural panels made from alder had properties which far exceed minimum standards established for structural panel products (National Bureau of Standards, 1966). Concerning the effect of an OSB plant on the economics of harvesting alder, Wright makes the point that such a mill would provide an outlet for low grade material, thereby enhancing the value of the resource as a whole.

8 Seattle, Portland, San Francisco, L.A., Phoenix.

CONCLUSIONS

- The hardwood resource in the mid 1980's supported an industry involved in log exports, lumber, veneer and chip manufacture that generated sales of approximately $190 million.

- About $53 million (28%) of the sales were due to exports. Chip, lumber, and log export sales accounted for 53%, 38%, and 9% respectively.

- The $137 million (72%) of sales for domestic use were dominated by lumber (51%) and chips (47%).

- The information gathered suggests that about 10% of the lumber volume produced and 22% of the value goes into export; the disproportionally high value percentage reflects the export market purchasing primarily higher grades.

- The chip market is presently about 30% exports and domestic and export sales have grown sharply in recent years.

- The total cost of logs that supports this activity appears to be on the order of $85 million of which $5 million represents sales of export logs.

- Comparing the average value of sales/MBF log scale to the average cost of logs delivered to domestic mills ($140/MBF) sugggests relatively high value-added in log manufacture of 150%. Even with a high average log cost of $200/MBF value-added is estimated to be 75%.

- Although the data collected suggest a growing and healthy industry, there may be pressures developing regarding available resource supply. Old inventory data suggest that log harvest is somewhat less than half of sawtimber growth. However, forest industry activities related to conversion of older hardwood stands to conifers and eradication of hardwoods in young stands, urbanization, and streamside buffer zone restrictions raise serious questions as to how much hardwood resource is available and how much is developing for the future.

- On a positive note, there appear to be many opportunities for continued growth of overseas markets and for further value-added manufacturing using technologies that have been developed elsewhere for hardwoods and can be readily adopted.

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APPENDIX I

PNW SPECIES DESCRIPTIONS

This appendix presents brief descriptions of the Pacific Northwest hardwoods giving scientific names, geographic distribution, general tree characteristics, wood properties, and uses. Specific gravity, shrinkage and strength property data, compiled from various sources are presented in Table 21. Strength properties are reported at 12% moisture content (dry weight basis) except for a few values in parenthesis based on tests in the green condition. The sample size forming the basis for many of these values is often quite small hence, values reported here could differ significantly from a particular piece. These values should, however, be useful in comparing these with other, more familiar species. The reader is referred to the *Wood Handbook* (USDA, 1987) which lists comparable values for many other North American and foreign woods.

Red Alder ——*Alnus rubra*, Bong.
Family: Betulaceae

Distribution Pacific coast from Southern California through the Alaska panhandle. Best growth is at elevations below 2500 feet. *General Characteristics* Commonly reaches 80-130 feet height and 10-36 inches diameter. Fast growing, producing sawlogs in 35-50 years. Achieves best development on moist sites along streams and river bottoms, generally in pure, even-aged stands. Easily invades conifer sites after logging or fires and forms pure stands or mixtures with conifers. Stands usually mature at 50-60 years and often deteriorate rapidly beyond this age. In close grown stands, alder is a good self-pruning species at an early age and is thus capable of producing a large percentage of high quality clear wood. Trees may develop adventitious surface branches, particularly if the stand becomes more open. *Wood Properties* Red alder is a relatively lightweight hardwood with average specific gravities of 0.37 (oven-dry weight/green volume) and 0.41 (oven-dry weight/volume at 12% MC). It is free from significant specific gravity differences between spring and summerwood (Maloney, 1978). The following densities have been reported for red alder lumber:

2.36-2.45 lb/BF at 6-8% MC (McGillivray, 1981a)
23 lb/CuFt. dry and 46 lb./CuFt. green (Nielson, 1977)
24.9 lb/CuFt. at 8% MC (Leney, Jackson, Erickson, 1978)

Red alder is a diffuse porous wood whose vessels (pores) are small and evenly distributed throughout the annual ring. This gives the wood a uniform grain and a fine, smooth texture (Leney, Jackson, Erickson, 1978). A very subtle figure is formed by the narrow band of summer wood, while randomly distributed aggregate rays add lines of gray to the tangential (flat-sawn face). Two major disadvantages of alder are: 1) The tendency for trees to develop growth stresses and crookedness in the bole; 2) The lack of resistance to chemical stain and decay in both the log and products. (Leney, Jackson, Erickson, 1978). Growth stresses can be quite dangerous, causing barber chair during felling, shifting in the dogs during sawing, and splitting during edging (Leney, Jackson, Erickson, 1978). Alder's annoying lack of resistance to decay limits log storage to 6-8 weeks in summer, 8-12 weeks in winter (Nielson, 1977). Logs are subject to incipient decay and blue stain, while green alder lumber and chips turn red from the chemical stain oregonan, if they are not promptly dried (Kozlik, 1978). Even when properly dried, alder lumber is not particularly resistant to decay and should not be used in environments where excess moisture or ground contact are anticipated (USDA 1987). Nielson (1977) reported that alder is not a preferred species for furniture manufacture. This is primarily due to its low hardness and bending strength compared to such preferred species as yellow birch, beech, and maple (USDA 1987). The Wood Handbook (USDA 1987) describes various treatments for modifying wood (impreg., compreg., etc.) which can be used to improve hardness, along with resistance to decay, fire, and moisture absorption. Rowell and Konkel (1987) enlarged upon this theme. In one example of modified wood, Bryant (1948) demonstrated that the sidegrain hardness of soft ponderosa pine could be increased to that of sugar maple by phenolic resin impregnation.

In addition, Bryant (1987) was involved in a commercial operation in which red alder desk legs were densified by heat under pressure to increase side-grain hardness. Alder is generally acknowledged to be above average in workability. The wood is easily machined, glued, sanded, and finished (McGillivray, 1981a; Nielson, 1977), and it polishes nicely (Leney, Jackson, Erickson, 1978). Touted as one of the best woods for turning (Resch, 1980), alder was found to produce 88% fair to excellent turnings at 6% MC (Koch, 1964). It is said to take nailing without splitting (WA State Dept. of Commerce and Economic Development, 1964), and indeed to "outperform oak in nailholding" (Beachy, McMahon, 1987). Screwholding strength is equivalent to that of maple, birch, or oak, when either screw diameter is increased by one size or screws 1/4" longer are used (Behm, 1984). The dimensional stability of dry alder lumber is quite good (Leney, Jackson, Erickson, 1978). Total shrinkage from green to dry is 4.4% radial, 7.3% tangential, and 12.6% volumetric (USDA Forest Products Laboratory, 1987). Two special qualities are worthy of note. First, because of its evenly distributed network of vessels, alder is easily penetrated by liquids such as fire retardants, preservatives, resins, stains, and paints. Second, this species responds well to steam bending treatments used in manufacture of steam-bent furniture (Resch, 1980). Alder's anatomy gives it a consistent appearance throughout the annual ring, with but a subtle change in grain between springwood and summerwood. An additional feature of the species is its uniformity of color between heartwood and sapwood, minimizing the sorting necessary to obtain consistency of hew (Leney, Jackson, Erickson, 1978). Although this subtle appearance has been a handicap in a U.S. furniture market geared toward the bold look of oak, recent customer surveys show a return to the more reserved style of diffuse porous hardwoods (Behm, 1984; Curtis, 1987). Alder is white when first cut, yet it soon turns a pinkish tint if not promptly dried, because of the tendency towards chemical staining previously mentioned (Leney, Jackson, Erickson, 1978). Proper drying gives lumber the honey brown color desired by buyers. Several writers have dealt with kiln drying techniques for achieving the desired appearance and avoiding sticker stain (Anderson, Frashour, 1954; Kozlik, 1967; Kozlik, 1978; Kozlik, Boone, 1987). Nielson (1977) states that air drying gives alder a mottled appearance. However, a beautiful golden brown vaulted ceiling made from air dried alder was recently seen by the author. Once dried, alder holds its color well, outperforming maple and birch in ultraviolet tests (Behm, 1984). This makes the species especially well suited for unfinished furniture. Paint is held well by this wood, and grain patterns do not telegraph through the paint (Leney, Jackson, Erickson, 1978). In addition, the species is very flexible with regard to taking stains (Behm, 1984; Resch, 1980). This flexibility allows alder to "simulate more expensive woods" (Nielson, 1977) and it is reputed to "imitate beech, birch, cherry, maple, and walnut" (McGillivray, 1981a). Because of the tendency for alder trees to grow adventitious branches, pin knots are relatively common in the resulting lumber. The National Hardwood Lumber Association grading rules for red alder therefore specify that pin knots are not to be considered as defects (PKND) (Fye, Briggs, 1978). This need not prove a drawback, however, since 60% of customers prefer wood containing small, tight knots in high-priced cabinets to give the piece more character (Behm, 1984; McGillivray, 1981a). In terms of fiber length, red alder ranks in the lower half of hardwood species (whose fibers range in length from 0.6 to 2.3 mm). Red alder fibers average 1.2 mm in length.[9]

Alder pulp has good bulk, improves formation, and is easy to bleach. This stock is similar to the more familiar birch pulp in its advantageous printability, smoothness, and softness aspects (Hrutfiord, 1978; Resch, 1980). While the opacity and surface characteristics of alder pulp are useful for writing paper production, its softness is appreciated in tissue manufacture, and its bulk is useful for bond paper (Fay, 1987). With regard to yield, sulfite or bleached kraft to a K number of 14 gives a 45% yield, while the Permochem process produces tissues with an 85% yield and with no need for bleaching. Among the disadvantages of using alder for pulp are (Hrutfiord, 1978):

1. With its shorter fiber lengths, hardwood pulp is not as strong as softwood pulp.

9 By contrast, the softwoods have fibers of between 1 and 7 mm in length (Leney, Jackson, Erickson, 1978).

2. Debarking of alder is a problem, except in spring or early summer and soon after harvest.[10]

3. Because of problems with oregonan stain, log storage is limited to 30 days in summer, 90 days in winter.

4. Chip storage is also limited to one month. If left for longer periods, yield, strength, color, and pulpability all suffer.

5. The spent sulfite liquor recovery process produces twice the biological oxygen demand (BOD) as with softwoods.

Uses Furniture, paneling, millwork, woodenware, novelties, pulp, veneer, pallets.

Bigleaf maple —— *Acer macrophyllum*, Pursh.
Family: *Aceraceae*

Distribution Pacific coast from Southern California to Southern tip of Alaska, best development on rich bottomlands. *General Characteristics* Reaches 100 feet in heighht and 36-48 inches dbh generally scattered or in small groves mixed with other species. Grows rapidly during first 40-60 years; maturity in 200-300 years. In closed forests, limb free for 1/2-2/3 of total height while in more open grown conditions may have a relatively short main trunk before it forks. *Wood Properties* Diffuse porous, sapwood reddish white sometimes with grayish cast; heartwood pinkish brown. Differs from eastern soft maples which lack pinkish cast. Growth rings not very distinct. Usually fine straight grained but frequently with quilted, curly or birds-eye figure. Old trees often have burls that are highly prized. Fairly heavy, moderately hard, excellent glue ability, finishing and workability. *Uses* Furniture, cabinet work, paneling, flooring, woodenware, novelties, toys, handles, veneer, boxes, pallets, crates. Better grades often substituted for hard maple in furniture. An excellent wood for manufacture of pianos (Minore, 1984).

Black Cottonwood —— *Populus trichocarpa*, Torr. and Gray
California Poplar
Family: *Salicaceae*

Distribution Alaska and Yukon territory south through British Columbia, Washington, Oregon, Western Montana and Idaho and California. *General Characteristics* Attains 100 feet in Rocky Mountains, 175-200 feet and 7-8 feet diameter along parts of the coast. Forest trees develop long clean boles. Best on moist sandy gravelly or deep alluvial soils. Limited pure stands on new river bars or mixed with other species. Rapid growth, maturity in 150-200 years. Has great potential as an intensively managed short rotation plantation pulpwood species. *Wood Properties* Diffuse or semi-ring porous. Sapwood whitish merging into heartwood that is grayish white, light grayish brown or brown. Transition is often not clearly defined. Inconspicuous often wide growth rings. Usually straight grained with little figure. Light, soft, surface tends to fuzz when machinied, easy to glue, resistant to nail splitting, but poor nail-holding ability, low durability, moderate finishing quality. *Uses* Pulp, veneer for plywood cores and boxes, lumber for crating, packaging, and concealed furniture parts.

California Black Oak —— *Quercus Belloggii*, Newb.
Family: *Fagaceae*

Distribution Central Oregon south along California Coast ranges and west slopes of Sierras. Generally 1500-9000' in elevation. *General Characteristics* Usually 50-80 feet in height and 18-30 inches dbh though much larger individuals occur. Generally has a short somewhat crooked bole. Found on dry gravelly or sandy soils of canyon floors, beaches or mountain slopes. May be in open groves or limited pure

10 Powdered alder bark makes a good plywood glue extender (Rucker, 1987).

stands. Often with other species at lower elevations. *Wood Properties* Ring porous, classified as a red oak. Sapwood grayish white to pale reddish brown; heartwood pink to light reddish brown. Growth rings distinct. Heavy, hard, machines well with power tools but hard to work with hand tools. Carving and turning require sharp cutting tools. Coarse distinctive figure. Difficult to dry without checking and splitting. *Uses* Relatively little used but suitable for any uses of red oak where hardness and strength are needed. Note: Another member of the red oaks, *Quercus douglasii*, Hook and Arn. krown as Blue Oak is also found in portions of California.

California laurel —— *Umbellularia californica*, Nutt.
Oregon myrtlewood
Family *Lauracacea*

Distribution Central Oregon south through coast ranges and Sierras to southern border of California. *General Characteristics* On best sites can reach 100-175 feet in height and 36-72 inches in diameter but more typically reaches about half that size. On poor soils it can be shrubby. Bole, even in forest conditions, often forks near the ground into several ascending limbs. *Wood Properties* Diffuse porous, thick sapwood, white to light brown; heartwood light brown to grayish brown, often with dark, sometimes black, regions. Growth rings distinct. Fine grain with attractive figure. Spicy odor. Often has burls. Moderately hard, heavy, machines well, one of the best woods for turning and carving. Polishes to a smooth surface. Excellent finishing. Durable. *Uses* Veneers, novelties, woodenware turnings, gun stocks, furniture and cabinet work.

Canyon live oak —— *Quercus chrysolepis*, Liebm.
Family: *Fagaceae*

Distribution Southwestern Oregon south through coast ranges and west slopes of Sierras in California and eastward through mountainous regions of central and southern Arizona and southwestern New Mexico. *General Characteristics* Commonly 60-80 feet in height and 12-60 inches diameter. Bole is rather short but may be clear for 20-40 feet on best sites. Above bole divides into massive limbs. *Wood Properties* Semi-ring porous. Color is light brown. Distinct rings. Fine to coarse grain. Very heavy stiff, tough, and strong. *Uses* Limited at present. Would be useful in applications requiring exceptional strength and toughness.

Chinquapin —— *Castanopsis chrysophylla*, (Doug.) A.DC.
Golden Chinquapin
Giant Evergreen Chinquapin
Family: *Fagaceae*

Distribution From southern Puget Sound, Washington along the western slopes of the Cascades through Oregon and along California coastal ranges to San Jacinto Mountains. *General Characteristics* Never more than a large shrub in Washington, attaining tree size in Oregon and California. Generally reaches 60-80 feet in height and 30-40 inches diameter, although much larger individuals are found in the best growing conditions in Northern California. In forest conditions develops a clear bole for 1/2 - 2/3 of length. Moderately rapid growth, maturity in 200-500 years. Can form pure stands over wide areas on poor dry soils; also found in mixtures with conifers. *Wood Properties* Ring porous. Narrow light brown sapwood with pinkish tinge, may be difficult to distinguish from heartwood though heartwood is often somewhat darker. Moderately heavy, fairly hard. Good woodworking properties, glues and finishes well. *Uses* Paneling, furniture and novelties.

Oregon Ash —— *Fraxinus latifolia*, Benth.
Family: *Oleaceae*

Distribution Southern coastal British Columbia along the coast to San Francisco Bay and lower western slopes of Sierras to Southern California. *General Characteristics* Attains 60-80 feet height and

24-36 inches dbh, but can be much larger under the best conditions. Develops a clear symmetric bole. Prefers rich moist bottomland sites but is also found on moist sandy, gravelly or rocky sites. Usually in mixtures with other species but may be in pure stands along banks of streams or margins of swamps. *Wood Properties* Ring porous. Wide sapwood nearly white, heartwood brown, gray brown or yellow brown. Growth rings distinct. May be slightly lighter than eastern ashes but comparable in general appearance, qualities and strength. *Uses* Baseball bats, oars, tennis rackets, snowshoes, handles, furniture, paneling, flooring, toys, woodenware, baskets. Not distinguished from eastern white ash in trade.

Oregon White Oak —— *Quercus garryana*, Dougl.
Garry Oak
Family: *Fagaceae*

Distribution Washington, Oregon, Northern California

General Characteristics The only oak that is indigenous to the Pacific Northwest reaching 50-70 feet in height and 24-36 inches diameter. The bole is typically short and crooked. Grows in almost any soil but develops best on dry rich loam. Best development is in southern Oregon and northern California where it may form small, pure stands. Elsewhere it is an occasional tree in mixed stands. *Wood Properties* Ring porous. Narrow sapwood is gray white to light brown; heartwood light to dark brown. Growth rings very distinct. Wood is heavy and hard, machines well with power tools but hard to work with hand tools. Carving and turning require sharp cutting tools. Has coarse, distinctive figure. Difficult to dry without checking and splitting. *Uses* Furniture, flooring, structural timbers. Suitable for any uses of eastern white oaks where hardness and strength are needed. Note: Another member of the white oaks, *Quercus lobata*, Nec., known as California white oak or Valley oak is found in western California lower valley sites and is the largest of the western oaks.

Pacific Dogwood —— *Cornus nuttalli*, Aud.
Family: *Cornaceae*

Distribution Southern British Columbia south through western Washington and Oregon to San Bernadino Mountains of California and on west slopes of Sierras. *General Characteristics* Rarely reaches 60 feet height, maximum diameter 12-20 inches. Best development in Puget Sound basin and California redwood region. Usually an understory species. *Wood Properties* Diffuse porous. Wide sapwood, pale red to reddish brown; heartwood when present is dark brown. Growth rings distinct but not sharply delineated. Fine grained, dense, hard, strong, and tough. *Uses* Turnings, shuttles, spools, bobbins, etc. Major uses depend on hardness and fine texture which cause it to stay smooth under continuous wear.

Pacific Madrone —— *Arbutus menziesii*, Pursh.
Family: *Ericaceae*

Distribution Coastal British Columbia western Washington and Oregon to Southern California in both coastal and Sierra ranges. *General Characteristics* Attains 80-125 feet height and 24-48 inches diameter. Forms a clear symmetruc bole in dense stands but often has a short crooked stem otherwise. Found on a variety of soils but is best developed on well drained soils near level. In pure stands or mixtures with conifers and other hardwoods. Can reach sawlog size in 50-60 years and lives 100-500 years. *Uses* Furniture, shuttles, veneer, novelties, toys, woodenware, turned items.

Tanoak —— *Lithocarpus densiflorus*, Rehd.
Tanbark oak
Family: *Fagaceae*

Distribution Southern Oregon south along California coast ranges and in Sierras. *General Characteristics* Normally reaches 70-90 feet height and 24-36 inches dbh. Boles of forest trees are clear, often not symmetric. Boles of open grown trees are short and support a maze of limbs. Usually mixed with other species but nearly pure stands may develop from sprouts on cutover areas. *Wood Properties* Semi-ring porous. Wide sapwood light reddish brown when first cut, turning darker with age, becoming more difficult to distinguish from heartwood. Growth rings indistinct. Low durability due to wide sapwood but is easily treated with preservatives. Works easily, hard, heavy, strong, and takes an excellent finish. In many ways, similar properties to eastern white oaks, except for compression perpendicular to grain and greater shrinkage. *Uses* Tannin from bark, pulpwood. Flooring in homes, commercial buildings and trucks, Treated for railroad ties. Suitable for decorative and industrial veneer and high quality furniture.

Table 21. Properties of West Coast Hardwoods[1]

Species	Specific gravity (oven dry weight, green volume)	% shrinkage from green to oven-dry, based on green dimensions			Static bending[2]			Import bending	Compression
		Volumetric	radial	tangential	Modulus of Rupture lb per sq. in.	Modulus of Elasticity 1000 lb per sq. in.	Work to maximum load in.-lb per cu. in.	height of 50 lb drop to failure inches	parellel to grain crushing strength lb per sq. in.
Alder, red	.37	12.6	4.4	7.3	9,800	1,380	8.4	20	5,820
Ash, Oregon	.50	13.2	4.1	8.1	12,700	1,360	14.4	33	6,040
Chinquapin, Golden	.42	13.2	4.6	7.4	10,700	1,240	9.5	30	5,540
Cottonwood, black	.31	12.4	3.6	8.6	8,500	1,270	6.7	22	4,500
Dogwood, Pacific	.58	17.2	6.4	9.6	10,500	1,470	11.0	34	7,540
Laurel, California	.51	11.9	2.8	8.1	8,000	940	8.2	31	5,640
Madrone, Pacific	.58	18.1	5.6	12.4	10,400	1,230	8.8	23	6,880
Maple, Bigleaf	.44	11.6	3.7	7.1	10,700	1,450	7.8	28	5,950
Oak, California black	.51	12.1	3.6	6.6	8,700	990	6.5	16	5,640
Oak, Canyon live	.70	16.2	5.4	9.5	12,900	1,610	9.9	37	9,080
Oak, Oregon white	.64	13.4	4.2	9.0	10,300	1,100	9.8	29	6,530
Tanoak	.58	17.3	4.9	11.7	(10,500)	(1,550)	(13.4)	NA	8,172

[1] Sources: (USDA Forest Products Laboratory 1987, Pheiffer 1953)
[2] All strength properties at 12% MC except those in ( ) which are green

Table 21. Continued.

	Compression Perpendicular to grain; fiber stress at proportional limit lb. per sq. in.	Side Hardness; load to embed a .444 in. ball to 1/2 its diameter lb.	Shear Parallel to grain; maximum shearing strength lb. per sq. in.	Tension Perpendicula to grain; maximum tensile strength lb. per sq. in.
Alder, red	440	590	1,080	420
Ash, Oregon	1,250	1,160	1,790	720
Chinquapin, Golden	680	730	1,260	(480)
Cottonwood, black	300	350	1,040	330
Dogwood, Pacific	1,650	1,350	1,720	1,040
Laurel, California	1,400	1,270	1,860	870
Madrone, Pacific	1,620	1,460	1,810	(770)
Maple, Bigleaf	750	850	1,730	540
Oak, California black	1,440	1,100	1,470	770
Oak, Canyon live	2,260	2,420	2,290	(970)
Oak, Oregon white	2,110	1,660	2,020	830
Tanoak	1,656	NA	(1960)	NA

APPENDIX II

THE U.S. DEPARTMENT OF COMMERCE STATISTICS

Tables 22 through 29 were compiled from U.S. Department of Commerce statistics. These tables show a 10-year trend of trade data for selected hardwood exports from the Pacific Northwest. The first four tables deal with volumes, while the second four concern value. An attempt was made to single out those items which may originate from Pacific Northwest timber stock. Although the designation "Pacific Northwest" includes customs districts of Portland, OR., Seattle, WA., Anchorage, AK., and Great Falls, MT, Tables 25 and 29 demonstrate that for the particular hardwood products included in the tables -excepting 202.4375[11] - one can safely assume that Seattle and Portland customs districts account for nearly 100% of the volume and value exported. Concerning the $931,000 of "dressed or worked hardwood lumber, unspecified species" (shown in Table 29) which was not from Washington or Oregon, this material originated at Anchorage and presumably consisted of Alaskan birch (*Betula papyrifera*). Tables 25 and 29 compare the role played by Seattle and Portland customs districts in accounting for total U.S. exports of the specified products to Japan. The customs categories are generally too broad to identify specific PNW hardwoods. However, starting in 1987, a new schedule B number 202.4371 will now refer to "Western red alder, rough lumber." It is expected that this number will reflect a trade flow easily attributable to Pacific Northwest hardwood. Since most PNW red alder produced is sold surfaced and dried, it is hoped that the U.S. Department of Commerce will also add a designation of "Dressed or worked Western red alder."

Tables 24 and 28 show that there is no consistent pattern to Japan's involvement with any product except 202.4375 ("Dressed or worked hardwood lumber, unspecified species.") Over half of PNW hardwood trade consistently falls into this category and Japan has been the main sponsor of this trade flow. According to Araman (1986), it consists mostly of kiln-dried, surfaced red alder lumber being used by the Japanese to craft furniture for their domestic consumption. The growth of this one trade flow has caused the overall value of PNW hardwood trade to dramatically increase while Japan's share also grew.

11 "Dressed or worked hardwood lumber, unspecified species." This numbering system is explained in the U.S. Dept. of Commerce publication, **Classification of Exports, Schedule 2.**

Table 22. Exports of Hardwood Products from the Pacific Northwest * TO JAPAN on a VOLUME basis

Schedule B Number and Commodity Description**	1978	1979	1980	1981	1982	1983	1984	1985	1986
				(Quantity in MBF)					
I. Rough logs and Timber except pulpwood									
200.3529 Maple	519	108	740	478	514	515	122	271	625
200.3536 Unspecif. species	416	1,870	5,793	1,438	594	573	3,064	607	2,114
II. Lumber, rough, dressed, worked									
A. Maple, birch, beech									
202.4312 Rough hard maple	107	65	102	258	128	2,511	577	30	461
202.4314 Other rough	0	1	469	301	25	360	538	61	120
202.4315 Dressed or worked	51	23	144	467	97	77	623	206	191
B. Unspecified species(mostly alder)									
202.4370 Rough	53	411	635	878	1,672	3,769	5,799	5,537	3,332
202.4375 Dressed or worked	3	49	585	883	1,294	7,868	17,201	18,988	26,962
III. Veneer				(Quantity in MSF)					
240.0120 Maple	0	0	0	21	37	22	395	55	86
240.0150 Unspecif. Species	846	764	1,367	800	12,663	1,745	1,184	22	512

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.
Source: U.S. Department of Commerce Data Series EA622:U.S., Exports-Annual. Washington D.C., The Dept., Published annually.

Table 23. Exports of Hardwood Products from the Pacific Northwest* to ALL NATIONS on a VOLUME BASIS

Schedule B Number and Commodity Description**	1978	1979	1980	1981	1982	1983	1984	1985	1986
				(Quantity in MBF)					
I. Rough logs and Timber except pulpwood									
200.3529 Maple	761	214	946	701	645	1,464	585	1,160	1,594
200.3536 Unspecif. Species	700	2,207	6,571	2,059	2,678	2,455	4,233	2,099	4,024
II. Lumber, rough, dressed, worked A. Maple, birch, beech									
202.4312 Rough hard maple	203	320	1,019	2,169	965	3,354	1,145	1,567	2,635
202.4314 Other rough	313	285	1,090	1,094	286	1,302	669	216	478
202.4315 Dressed or worked	545	504	598	935	491	718	1,382	815	738
B. Unspecified species (mostly alder)									
202.4370 Rough	5,006	4,720	6,626	7,972	7,137	9,428	9,860	8,646	7,993
202.4375 Dressed or worked	4,034	5,599	4,082	6,974	5,663	12,447	20,595	21,078	30,298
III. Veneer				(Quantity in MSF)					
240.0120 Maple	158	13	10	21	63	22	456	131	1,143
240.0150 Unspecif. Species	3,128	3,760	3,078	4,716	13,922	5,324	9,869	8,768	14,944

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.
Source: U.S. Department of Commerce Data Series EA622: U.S., Exports-Annual. Washington D.C., The Dept., Published annually.

Table 24. Exports of Hardwood Products from the Pacific Northwest * TO JAPAN (as a PERCENTAGE OF PNW EXPORTS TO ALL NATIONS: VOLUME BASIS)

Schedule B Number and Commodity Description**	YEAR 1978	1979	1980	1981	1982	1983	1984	1985	1986
I. Rough logs and Timber except pulpwood									
200.3529 Maple	68.2%	50.5%	78.2%	68.2%	79.7%	35.2%	20.9%	23.4%	39.2%
200.3536 Unspecif. species	59.4%	84.7%	88.2%	69.8%	22.2%	23.3%	72.4%	28.9%	52.5%
II. Lumber, rough, dressed, worked									
A. Maple, birch, beech									
202.4312 Rough hard maple	52.7%	20.3%	10.0%	11.9%	13.3%	74.9%	50.4%	1.9%	17.5%
202.4314 Other rough	0.0%	0.4%	43.0%	27.5%	8.7%	27.6%	80.4%	28.2%	25.1%
202.4315 Dressed or worked	9.4%	4.6%	24.1%	49.9%	19.8%	10.7%	45.1%	25.3%	25.9%
B. Unspecified species (mostly alder)									
202.4370 Rough	1.1%	8.7%	9.6%	11.0%	23.4%	40.0%	58.8%	64.0%	41.7%
202.4375 Dressed or worked	0.1%	0.9%	14.3%	12.7%	22.9%	63.2%	83.5%	90.1%	89.0%
III. Veneer									
240.0120 Maple	0.0%	0.0%	0.0%	100.0%	58.7%	100.0%	86.6%	42.0%	7.5%
240.0150 Unspecif. Species	27.0%	20.3%	44.4%	17.0%	91.0%	32.8%	12.0%	0.3%	3.4%

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.
Source: U.S. Department of Commerce Data Series EA622:U.S., Exports-Annual. Washington D.C., The Dept., Published annually.

Table 25. Exports of Hardwood Products from VARIOUS CUSTOMS DISTRICTS to JAPAN for YEAR 1985 on a VOLUME BASIS

Schedule B Number and Commodity Description**	PNW*:	PORTLAND	SEATTLE	BOTH	BOTH AS % OF PNW	U.S.	BOTH AS % OF U.S.
	FROM CUSTOMS DISTRICTS (Volumes in Thousand Board Feet)						
I. Rough logs and Timber except pulpwood							
200.3529 Maple	271	62	209	271	100%	274	99%
200.3536 unspecif. species	607	56	551	607	100%	3,501	17%
II. Lumber, rough, dressed, worked							
A. Maple, birch, beech							
202.4312 Rough hard maple	30	14	16	30	100%	3,183	1%
202.4314 Other rough	61	55	6	61	100%	601	10%
202.4315 Dressed or worked	206	76	130	206	100%	369	56%
B. Unspecified species (mostly alder)							
202.4370 Rough	5,537	312	5,225	5,537	100%	9,319	59%
202.4375 Dressed or worked	18,988	1,816	13,850	15,666	83%	20,512	76%
III. Veneer							
	(Volumes in Thousand Square Feet, 3/8 Basis)						
240.0120 Maple	55	0	55	55	100%	106	52%
240.0150 Unspecif. Species	22	0	22	22	100%	214	10%

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.
Source: U.S. Department of Commerce Data Series EA622:U.S., Exports-Annual. Washington D.C., The Dept., Published annually.

Table 26. Exports of Hardwood Products from the Pacific Northwest to JAPAN on a VALUE BASIS

Schedule B Number and Commodity Description**	YEAR								
	1978	1979	1980	1981	1982	1983	1984	1985	1986
	(F.A.S. Value Basis in Thousands of U.S. Dollars)								
I. Rough logs and timber except pulpwood									
200.3529 Maple	110	27	241	202	272	193	102	136	400
200.3536 Unspecif. species	152	780	1,708	1,226	205	144	1,009	579	1,644
II. Lumber, rough dressed, worked									
A. Maple, birch, beech									
202.4312 Rough hard maple	48	46	67	109	37	953	217	10	175
202.4314 Other rough	1	3	215	196	24	192	370	41	71
202.4315 Dressed or worked	42	15	85	264	52	54	384	102	91
B. Unspecified species (mostly alder)									
202.4370 Rough	33	487	405	653	1,297	2,779	4,360	4,214	2,482
202.4375 Dressed or worked	2	33	268	476	734	4,797	11,747	11,491	17,851
III. Veneer									
240.0120 Maple	0	0	0	3	5	6	30	11	10
240.0150 Unspecif. Species	53	69	166	140	416	145	125	3	82

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.
Source: U.S. Department of Commerce Data Series EA622:U.S., Exports-Annual. Washington D.C., The Dept., Published annually.

Table 27. Exports of Hardwood Products from the Pacific Northwest * to ALL NATIONS on a VALUE BASIS

Schedule B Number and Commodity Description**	YEAR 1978	1979	1980	1981	1982	1983	1984	1985	1986
	(F.A.S. Value Basis in Thousands of U.S. Dollars)								
I. Rough logs and timber, except pulpwood									
200.3529 Maple	177	138	330	258	335	379	237	485	910
200.3536 Unspecif. species	306	913	2,116	1,608	1,005	740	1,330	1,219	2,765
II. Lumber, rough, dressed, worked									
A. Maple, birch, beech									
202.4312 Rough hard maple	136	203	362	605	297	1,165	402	572	1,131
202.4314 Other rough	107	98	426	552	145	487	416	122	272
202.4315 Dressed or worked	139	221	301	472	226	283	660	283	285
B. Unspecified species (mostly alder)									
202.4370 Rough	2,173	3,327	5,123	6,585	5,767	7,418	7,633	6,788	6,332
202.4375 Dressed or worked	1,778	3,015	1,995	2,654	1,982	6,535	12,902	12,262	19,018
III. Veneer									
240.0120 Maple	12	23	9	3	8	6	41	15	47
240.0150 Unspecif. Species	258	401	325	358	505	354	806	618	1,549

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.2
Source: U.S. Department of Commerce Data Series EA622:U.S., Exports-Annual. Washington D.C., The Dept., Published annually..

Table 28. Exports of Hardwood Products from the Pacific Northwest to JAPAN (as a PERCENTAGE OF PNW EXPORTS TO ALL NATIONS: VALUE BASIS))

Schedule B Number and Commodity Description**	1978	1979	1980	1981	1982	1983	1984	1985	1986
(PERCENT)									
I. Rough logs and Timber except pulpwood									
200.3529 Maple	62.1%	19.6%	73.0%	78.3%	81.2%	50.9%	43.0%	28.0%	44.0%
200.3536 Unspecif. species	49.7%	85.4%	80.7%	76.2%	20.4%	19.5%	75.9%	47.5%	59.5%
II. Lumber, rough, dressed, worked									
A. Maple, birch, beech									
202.4312 Rough hard maple	35.3%	22.7%	18.5%	18.0%	12.5%	1.8%	54.0%	1.7%	15.5%
202.4314 Other rough	0.9%	3.1%	50.5%	35.5%	16.6%	39.4%	88.9%	33.6%	26.1%
202.4315 Dressed or worked	30.2%	6.8%	28.2%	55.9%	23.0%	19.1%	58.2%	36.0%	31.9%
B. Unspecified species (mostly alder)									
202.4370 Rough	1.5%	14.6%	7.9%	9.9%	22.5%	37.5%	57.1%	62.1%	39.2%
202.4375 Dressed or worked	0.1%	1.1%	13.4%	17.9%	37.0%	73.4%	91.0%	93.7%	93.9%
III. Veneer									
240.0120 Maple	0.0%	0.0%	0.0%	100.0%	62.5%	100.0%	73.2%	73.3%	21.3%
240.0150 Unspecif. Species	20.5%	17.2%	51.1%	39.1%	82.4%	41.0%	15.5%	0.5%	5.3%

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.
Source: U.S. Department of Commerce Data Series EA622:U.S., Exports-Annual. Washington D.C., The Dept., Published annually.

Table 29. Exports of Hardwood Products from VARIOUS CUSTOMS DISTRICTS to JAPAN for YEAR 1985 on a VALUE BASIS

Schedule B Number and Commodity Description**	FROM CUSTOMS DISTRICTS						
	PNW *	PORTLAND	SEATTLE	BOTH	BOTH AS % OF PNW	U.S.	BOTH AS % OF U.S.
I. Rough logs and timber, except pulpwood							
200.3529 Maple	136	53	82	135	99%	137	99%
200.3536 Unspecif. species	579	25	553	578	100%	5,490	11%
II. Lumber, rough, dressed, worked A. Maple, birch, beech							
202.4312 Rough hard maple	10	6	4	10	100%	864	1%
202.4314 Other rough	41	37	3	40	98%	470	9%
202.4315 Dressed or worked	102	51	51	102	100%	218	47%
B. Unspecified species (mostly alder)							
202.4370 Rough	4,214	214	4,000	4,214	100%:	7,353	57%
202.4375 Dressed or worked	11,491	1,264	9,296	10,560	92%	12,564	84%
III. Veneer							
240.0120 Maple	11	0	11	11	100%	24	46%
240.0150 Unspecif. Species	3	0	3	3	100%	28	11%

* Pacific Northwest includes customs districts of Portland, OR, Seattle, WA, Anchorage, AL, and Great Falls, MT.
** Schedule B Numbers: See U.S. Dept. of Commerce, Classification of Exports, Schedule 2.
Source: U.S. Department of Commerce Data Series EA622:U.S., Exports-Annual. Washington D.C., The Dept., Published annually.